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Edited by LEWIS STEPHEN PILCHER, M.D., LL.D., of New York

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PHILADELPHIA ACADEMY OF SURGERY

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ANNALS *of* SURGERY

VOL. XC

NOVEMBER, 1929

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THE SEMI-CENTENNIAL ANNIVERSARY OF THE FOUNDING OF THE PHILADELPHIA ACADEMY OF SURGERY

HELD APRIL 22, 1929

PRESIDENTIAL ADDRESS

BY ASTLEY P. C. ASHHURST, M.D.

On the evening of Monday, April 21, 1879, at the invitation of Dr. Samuel D. Gross, there met at his residence, southeast corner 11th and Walnut Streets, Philadelphia, the following surgeons, who may be regarded, with him, as the

FOUNDERS OF THE PHILADELPHIA ACADEMY OF SURGERY

SAMUEL D. GROSS, M.D., LL.D., D.C.L., Oxon.; D. HAYES AGNEW, M.D., LL.D.; RICHARD J. LEVIS, M.D.; ADDINELL HEWSON, M.D.; THOMAS G. MORTON, M.D.; WILLIAM H. PANCOAST, M.D.; JOHN H. PACKARD, M.D.; JOHN H. BRINTON, M.D.; J. EWING MEARS, M.D.; SAMUEL W. GROSS, M.D. Dr. Addinell Hewson acted as Temporary Chairman, and Doctor Mears as Secretary.

Subsequent informal meetings were held in April, May, June, October, November and December, 1879, at which other surgeons were present, and in the autumn of the year application was made for a Charter, by the following:

CHARTER MEMBERS OF THE PHILADELPHIA ACADEMY OF SURGERY

Samuel D. Gross, D. Hayes Agnew, Addinell Hewson, John H. Brinton, J. Ewing Mears, Thos. G. Morton, Samuel W. Gross, Oscar H. Allis, John H. Packard, Richard J. Levis, Charles T. Hunter, Wm. H. Pancoast, H. Lenox Hodge, John Ashhurst, Jr., De Forest Willard, Samuel Ashhurst, John B. Roberts, William W. Keen, William Hunt.

A Constitution and By-Laws having been adopted, and the Charter granted, under date of December 27, 1879, the Philadelphia Academy of Surgery commenced its honorable career.

Doctor Gross, the founder, announced, at the meeting of May 3, 1880, that he wished to offer a Prize, to be awarded every third year under the auspices of the Academy, the amount to be \$250. Subsequently, by bequest,

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he established the Samuel D. Gross Prize of the Philadelphia Academy of Surgery, to be awarded every fifth year "to the writer of the best original essay, not exceeding one hundred and fifty printed pages, octavo, in length, illustrative of some subject in Surgical Pathology or Surgical Practice, founded upon original investigations; the candidates for the prize to be American citizens." The amount of the award is now \$1500. Under this bequest seven awards have been made up to the present, and all but one of the recipients have complied with the provision established by the testator that the essay to which the prize has been awarded shall be published in book form by the competitor who receives the prize.

Doctor Gross also bequeathed to the Academy his personal library; this, known as the Samuel D. Gross Library of the Philadelphia Academy of Surgery, was, in the year 1884, placed on permanent deposit with the Library of the College of Physicians of Philadelphia. From the very beginning it has been the custom of the Academy to hold its meetings in one of the rooms of the building of the College of Physicians, and the care taken of our Library by the Librarian of the College, Mr. Charles Perry Fisher, and by the successive Library Committees of the College, has amply justified the Academy in having thus permanently secured such efficient custodians of its valuable collection of books. Additions to the Gross Library have been made from time to time, by gifts of books and money from members of Doctor Gross's family, and by funds provided by vote of the Fellows of the Academy. According to the last Report (1928) of the Library Committee of the College of Physicians, there were at that date a total of 3755 volumes in the Gross Library. Those volumes which comprised Doctor Gross's original library are kept in the Gross Library room on the ground floor of the building in which we are now meeting; accessions are housed in stacks, along with volumes of the College library.

Doctor Gross, himself a "self-made man," set high value upon education, upon study, research, and upon teaching. The commanding position which he occupied in the surgical profession not only of this country, but in most of the countries of Europe as well, is recognized to this day. It was to his foresight, to his power for organization, to his limitless enthusiasm for the profession of surgery, and his determination to see it established in this country upon a sure and lasting foundation that we owe not only the existence of the Philadelphia Academy of Surgery, but also that of the larger and still more influential national society, the American Surgical Association. By natural right he became the first president of both these societies.

It is partly because we, of the Philadelphia Academy of Surgery, have inherited from Gross a view of broad horizons, but also partly because they are our friends, that we have invited three distinguished American Surgeons—one each from the North, the South, and the West—to take the major part in our program of this Semi-centennial Meeting.

ACUTE ŒDEMA OF THE PANCREAS *

A CLINICAL AND EXPERIMENTAL STUDY

By EDWARD ARCHIBALD, M.D.

OF MONTREAL, CANADA

I HAVE to speak today on the subject of a certain phase of pancreatitis, which has not been much studied. It was brought to my notice through experimental work upon the etiology of acute pancreatitis. Perhaps it can be introduced in no better way than by relating the protocols of two experiments.

Cat 258.—I had introduced a tiny cannula into the pancreatic duct, through the opened duodenum. Upon allowing a small amount of clean gall-bladder bile, obtained by aspiration of the cat's own gall-bladder, to run into the pancreatic duct, watching at the same time the body of the pancreas, I was amazed to see with what rapidity the pancreas became congested and œdematous. Within a half minute one could observe the beginning of œdema, and within five minutes the greater part of the head and body of the organ was swollen, apparently to about half again its normal size, as the result of an acute, glassy, yellowish œdema, across which one could see running congested vessels. It looked almost translucent. The thin capsule of the pancreas was stretched out tightly as an almost transparent film.

Now, upon removing, after five or ten minutes, a cross section of the swollen œdematous area (See Fig. 1), and examining it microscopically, I found exactly the histological changes that the gross appearances suggested. The normal spaces of the stroma, interacinar as well as interlobular, stood out clearly under the microscope and were enormously widened. The vessels were choked with red cells, and one could also see some increase of white cells. Here and there one could find small extravasations of blood. In certain areas, not by any means in all (I speak now of the general run of similar experiments), one could see a change in the parenchymal cells. Either in the centre or in some other part of the group of cells forming an acinus, one could find areas of beginning necrosis, and this might be represented by no more than a cooked appearance of the protoplasm of a few cells, or might even be a definite necrosis of considerable extent. But in this specimen, in which clean, normal bile was used, necrosis was conspicuous, on the whole, by its absence, while œdema and congestion dominated the picture.

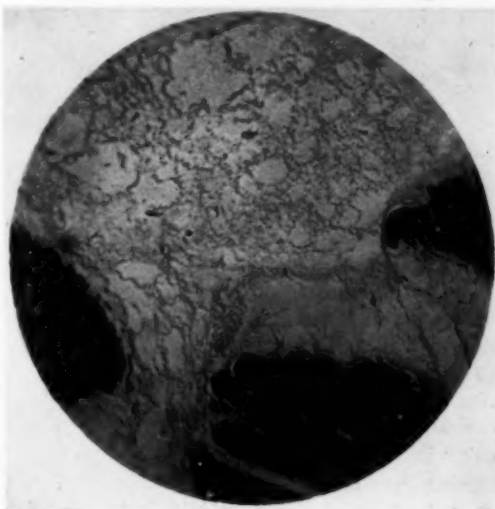


FIG. 1.—Cat 258. Note the very greatly widened spaces of the stroma, indicating œdema. Also in the three small islands of pancreatic tissue, otherwise normal, one can make out slight but definite separation of the tubules from each other as part of the same œdematous reaction.

* Read before the Philadelphia Academy of Surgery; Semi-Centennial Anniversary, April 22, 1929.

A few days later, I reopened the animal, and was amazed to find hardly a trace of the original oedema. Upon section and examination under the microscope (see Fig. 2),

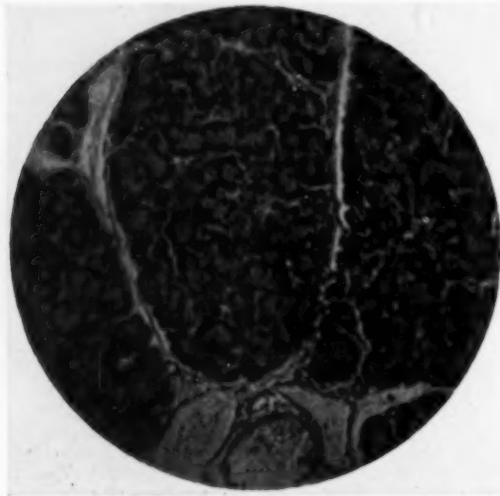


FIG. 2.—Cat 258. There can still be seen the evidence of slight oedema between the tubules, but the stroma has become practically normal. These microphotographs represent fairly the general look of the whole section.

one could see the persistence still of a mild oedema, but on the whole the acini were densely packed together. One could see small collections of lymphocytic infiltration; some leucocytosis in the vessels, chronic congestion, but otherwise the gland seemed normal.

Here, then we had before us a concrete fact: the fact that clean bile which had invaded the pancreas would cause an acute reaction, stopping, on the whole, short of necrosis, and that, in spite of the presumed fact of activation of pancreatic ferments by the bile, the process would not go on to what we call, in the human, acute pancreatic necrosis; on the contrary, that the inflammatory out-pouring of plasma could be reabsorbed in a few days, leaving the pancreas practically normal.

Cat, March, 1929.—Gall-bladder exposed, cystic duct ligated and cut between ligatures. Duodenum opened opposite the papilla, and cannula inserted into the common duct. In the course of the next hour and a half, two cubic centimetres of a pale yellow, watery bile were obtained. Upon this a twenty-gauge cannula was inserted without difficulty into the pancreatic duct. The cannula was large enough to permit an easy flow of the liver bile just obtained into the duct without the use of any pressure, the syringe barrel acting practically as a funnel. One and a half cubic centimetres of the bile in this way ran into the pancreas by gravity, during the next three minutes, so that any mechanical lesion of the pancreas through excessive pressure of the injection could be excluded. There resulted an immediate glassy oedema, involving the body chiefly, and the head also to a minor degree. The last inch of the tail remained free.



FIG. 3.—Cat of March, 1929. Another example of intense oedema, which, under this low power, can only be seen in the stroma.

A section was taken from the body for microscopical examination. The picture is seen in the accompanying microphotograph (Fig. 3), which shows an extraordinary degree of oedema, most marked between the lobules, but also present between the acini inside the lobules.

On the sixth day after operation the abdomen was reopened and the pancreas

ACUTE ŒDEMA OF THE PANCREAS

examined. The glassy œdema had quite disappeared, and there remained but little of the general swelling of the organ. Another piece was removed for microscopical examination, and the picture of the histological section corresponds with the gross appearance. The lobules are now set close together, œdema has disappeared, and in particular cell necrosis is conspicuous by its absence. (See Fig. 4.)

These observations, I may say, have many times been repeated, and one was able finally to arrive at the conclusion that when bile was not infected, whether it was mixed with mucus from the gall-bladder or came from the common duct as liver bile, unmixed with mucus, its entrance into the pancreatic duct was not likely to cause more than this acute pancreatic œdema, with congestion, which was capable of subsiding, and usually did subside completely within a relatively short time. On the other hand, if the bile were infected, whether mixed with mucus or not, it was likely to cause a much more intense effect upon the pancreas, chiefly in the way of extensive necrosis of parenchymal cells, considerable extravasation of blood, marked leucocytosis, and often secondary bacterial infections. Concerning these graver lesions I do not wish at this time to speak. My subject rather is the lighter forms of acute pancreatic œdema, undergoing prompt resolution; and my thesis, which I may as well state now, is this: That in the human there does occur an

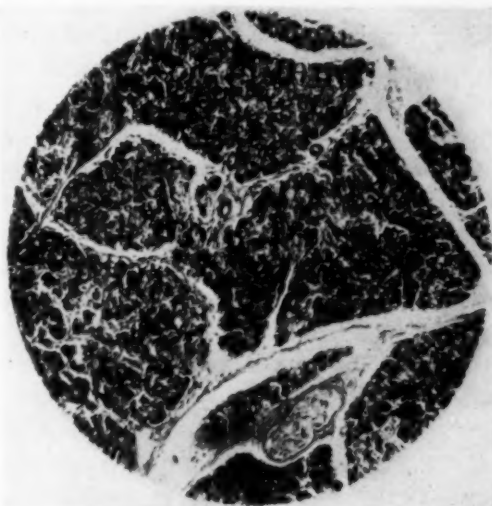


FIG. 4.—The legend of Figure 2 applies equally to this section.

analagous condition to that described in the animal; that this condition is almost certainly due to the entrance of bile into the pancreatic duct under abnormal circumstances, and that the œdema in like manner may subside rapidly. The hypothesis assumes further that this pathological condition constitutes the most probable explanation available for many of those attacks of more or less severe epigastric pain, which are met with so frequently in clinical practice, and which remain unexplained, at least to the satisfaction of the careful medical man. Such attacks are set down rather vaguely, and have been set down in the same way for hundreds of years, to indigestion, gastric upset, gastritis, neurosis or neuralgia of the stomach, intestinal dyspepsia, indiscretions of diet, and so on. They have been set down also, in late years, to some trouble in the gall passages, usually to stone. For the most part, subsiding as they do within twenty-four to forty-eight hours, the true diagnosis remains undiscovered. The patient may have many such attacks, and comes to speak familiarly, sometimes tolerantly, of his "indigestion." Naturally, patients suffering from these

comparatively transient symptoms are not brought to operation. Even when the diagnosis is made of abdominal colic, it is the rule to temporize, to give morphine hypodermically, and to wait until the attack has passed off. The attack does pass off, and when operation is performed in the interval, for presumed recurring attacks of gall-stones, the surgeon finds frequently, it is true, the expected gall-stones, *and* a normal pancreas. Naturally the pancreas seems normal, and probably is normal; the cedema has disappeared and there is nothing left to show that the organ, no longer than three or four days previously, was perhaps twice its normal size, and filled with a glassy cedema.

And another explanation of this failure to recognize the pancreatic change will doubtless suggest itself to you. Take that unfortunately large group of cases in which an exploratory laparotomy for undiagnosed acute abdominal conditions is done, and the wound is closed without the discovery of any satisfying lesion. Consider particularly the enormous number of rules of thumb operations for supposed appendicitis, in so many of which the removal of a normal-looking appendix constitutes the only reward (of the spirit, I mean), and to the patient a most dubious consolation for the distress of operation. May we not assume that a fair proportion of these are in fact cases of this same pancreatic cedema? For if the surgeon is not alive to the possibility of pancreatic cedema, and if his incision is made in the lower half of the abdomen, or indeed even in the upper half, it is almost inevitable that he will fail to discover the pancreatic swelling, the more so in that fat necroses are rarely present, and the pancreatic enlargement may not be great.

But you may well ask what proof have we that such a series of events in a case of this sort actually occurs in the human. My present conviction that it can and does occur was established twenty-one years ago, upon the occasion of operating upon a patient for a severe epigastric attack of pain which I had diagnosed as being due to acute pancreatitis. I will read you his case report.

The patient, a man, twenty-six years of age, first entered the hospital in September, 1907, with an acute attack of abdominal pain, so severe that half a grain of morphia relieved him very little. The pain was generalized over the whole abdomen. He recovered shortly and nothing was done. The diagnosis on admission was appendicitis, but this was altered to pancreatitis before discharge. He was readmitted on November 28, 1908, a year later, having had meanwhile seven or eight similar attacks, in all of which pain was so excruciating that large doses of morphia had practically no effect. The last attack began on November 24, at 11 P.M., with sharp, shooting pain in the epigastrium, followed two hours later by a dull pain across the lower half of the abdomen. Vomiting followed. During the three days before admission, the pain remained very severe, and in spite of heavy doses of morphia he could not sleep. He was unable to remain still, and the position in which he found most relief was prone on his face. The abdomen was found to be rather scaphoid, moving freely with respiration, symmetrical, and on palpation soft; no mass could be felt, but there was great tenderness in the epigastrium, if anything more marked to the right of the median line, though extending also to the left. There was occasional vomiting of bile-stained fluid. The stomach was not dilated. The bowels had not moved. The leucocyte count was 11,600, and a differential count revealed nothing abnormal. His urine was normal. On examining him for skin anæsthesia, a Head zone was found on the trunk, extending in the form of a band about two inches wide about the level of the umbilicus, transversely from the

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median line anteriorly, across the left side of the abdomen, to the median line posteriorly. Examination of the urine by Doctor Bruère, for lipase, showed that the urine caused marked hydrolysis of .55 cubic centimetres of butyric ether, in twenty-three hours, demonstrating that lipase was present. Control sample, boiled for ten minutes, was without action on butyric ether. Otherwise there was nothing relevant in the general examination. A diagnosis was made of acute pancreatitis, and operation carried out on November 30. By this time the condition was rapidly subsiding. Upon opening the abdomen the following observations were made. The peritoneum showed no signs of inflammation; the liver appeared healthy; the gall-bladder was partly filled with bile, seemed quite normal, and did not contain stones. The common duct was palpated and nothing found in it. The stomach and duodenum appeared normal, but the pancreas was decidedly firmer and larger than normal, and the enlargement involved practically the whole organ. It was not, however, exposed for direct inspection. A thorough examination of the rest of the abdomen, including the kidneys, spleen, cæcum, appendix, transverse and descending colon, revealed nothing abnormal. There were, however, a few palpable glands at the root of the mesentery. No peritoneal adhesions could be found.

At that time I had not come to formulate the principle of prolonged bile drainage as a therapeutic measure for the condition of pancreatitis, so that I closed the abdomen without doing anything more. Within two days the pain had practically disappeared, and he made an uninterrupted recovery and was discharged, feeling quite well, on December 18. The urine was examined by Doctor Bruère on December 8, who reported that no lipase was present.

On January 11, 1909, the patient was readmitted. He had remained quite well until about midnight on January 9, when he was awakened by a very severe pain, which began in the abdomen but soon extended all over the body, especially in the back and in the arms. The pain was excruciating and shortly he vomited. In the morning he felt better and got up, but the pain recurred with renewed violence; morphine was administered, three-eighths grain, and he obtained partial relief. The pain continued through the night, with vomiting, and he was admitted to the hospital on the morning of the 11th. Upon examination one found very marked tenderness in the epigastrium and also moderate tenderness over the whole abdomen. Upon careful thumb pressure there was found an area of extreme tenderness about two inches wide, midway between the umbilicus and the ensiform cartilage, extending from one inch to the right of the mid-line, to two and a half inches to the left. No mass could be felt. His pain was still severe, and continued so through that day and the following day. Morphine was given in doses of half a grain, five times in all, up to the evening of January 12, and he vomited several times. On the 13th he was better, although still suffering much pain in the back and shoulders. On the 15th and 16th he completed his recovery and was discharged apparently well. His temperature was practically normal throughout, save that on the 14th it went up to 101°, but came back to 99° on the following day. This corresponded with a fresh attack of moderate severity, which shortly disappeared after the exhibition of one-half grain of morphine. In the idea of adding an antiseptic to his bile, he was given urotropin, ten grains, three times a day, and was instructed to take it for three weeks, at which time he was to report. The urine on this occasion was not examined for lipase. The patient did not return for observation, and was lost sight of, but about a year later the medical officer of an insurance company sent in an inquiry, as the man was applying for insurance. It was then learned that he had, in the meantime, suffered one or more further attacks.

Here, then, we have an instance of a light attack of pancreatitis without coincident gall-stones or any other obvious cause, diagnosed clinically before operation, and apparently subsiding without treatment. Nothing was done at this operation on account of my ignorance of any promising mode of treatment; and the abdomen was simply closed. Although at the time I did not

expose the pancreas for direct inspection, I have no reason to doubt that a transitory lesion of the organ was the cause of his symptoms, and that that lesion was in the nature of an acute œdema and congestion, such as was later demonstrated in animal experiments. A year or two of experiment brought deeper knowledge, and, if he had returned, I should have drained his gall-bladder for one or two months; but he disappeared, and efforts to trace him were unsuccessful.

Since that time I have had, or at any rate taken, no second opportunity of operating on a comparable case. It is rare when a patient suffering from an acute attack of epigastric pain, which lasts no more than a few hours, is brought to the surgeon for operation. The comparatively early subsidence of the pain encourages the attending physician to wait, and the marked improvement, or even entire disappearance of symptoms on the following day, decides the surgeon against an operation which would then be only exploratory. On the other hand, the usual diagnosis under these circumstances is gall-stones, and inasmuch as it has for long been considered sound policy not to operate during an attack of gall-stone colic, a rule which is as strong in the mind of the surgeon as in that of the general practitioner, operation is not undertaken at the very moment when a secondary or even independent pancreatic œdema might be found, but only later, during the interval, when all pancreatic swelling has disappeared; or, on the other hand, during a prolonged acute attack when the pancreas is found to be the site of a grave and advanced pancreatitis. In other words, the surgeon usually misses exactly that stage at which a light grade of pancreatitis, with œdema, would, or might, be seen. Nevertheless, when one comes to analyze carefully the case histories of patients who are operated on finally for gall-stones, or for severe pancreatitis, or for both, one very frequently discovers an account of one or of many previous attacks, passing off within a few hours or a couple of days. While it is natural to ascribe such previous attacks to gall-stones, it often happens that no gall-stones can be found, and it becomes obvious that such previous attacks could be hardly anything else than mild attacks of pancreatitis, consisting presumably in this very condition of pancreatic œdema with congestion. I feel sure that the thoughtful surgeon has for long formulated such a conception in order to explain these previous mild attacks. But it is also true to say that the great majority of practicing physicians think of pancreatitis only as a most severe and dangerous disease, usually ending fatally. It is curious to notice how this attitude of the general practitioner coincides with that of the pathologist, and in the case of both because of insufficient experience. Every now and again it happens that a patient who has been operated on, let us say for disease of the gall passages, comes to autopsy after a few days or more, and the surgeon concerned, who has, as he thought, distinctly felt an enlarged pancreas, makes a point of asking the pathologist concerning the condition of the pancreas, and is amazed to hear the simple, yet positive answer, that there was nothing wrong with the pancreas. Upon expressing his surprise, the pathologist, with that superior air which characterizes those of his profession as being men

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who deal with demonstrable facts, merely shrugs his shoulders and suggests that the surgeon's conception of an enlarged pancreas was at fault. For, says he, tolerantly, and with a faint tinge of amusement, the pancreas is susceptible of many variations in size within normal limits. The result has been that many surgeons have come to distrust their opinion in such cases, and will set down in their report the note of an enlarged pancreas only when the enlargement is so gross that nobody could be of any other opinion. Only here and there does one find a surgeon who, being called upon to recant and confess, is of such an independent spirit as to exclaim, like Galileo, "*Eppur si muove*—it *was* swollen, anyhow!" Now the truth of such a matter, of course, is that both are right, but that the œdema, which increased the size of the organ to such an extent that the surgeon could feel it as enlarged, had disappeared during the intervening few days to such an extent that the pathologist would consider it normal.

Although such a pancreatic œdema is not infrequently found as a complication of gall-stone disease, it can also occur quite independently. In a series of some thirty-five cases of chronic pancreatitis which I analyzed in 1913, I found that, in approximately 50 per cent., gall-stones were conspicuous by their absence, and that in a further considerable proportion stones were present only in the gall-bladder and not in the common duct. And, indeed, this fact has long been a difficulty to those who roughly think of pancreatitis as being always secondary to disease in the gall passages. It was in the attempt to explain this large proportion of cases of independent pancreatitis that I suggested, about 1911, that bile might be forced into the pancreatic duct through a spasm of the sphincter of Oddi. This is a hypothesis which it is extremely difficult to prove in the human, but which I have been able to prove in animal experiments, and I confess that I am a convinced adherent of the theory which ascribes the cause of the great majority of instances of acute pancreatitis to the entrance of bile into the pancreatic duct. In this place I need say no more about this mode of causation than that I have found it possible in animals, by direct injection of bile, both normal and infected, into the pancreatic duct, or by forcing bile through an artificially induced spasm of the sphincter of Oddi into the pancreatic duct, to produce all grades of acute pancreatic disease, from the lighter forms, which are here in question, up to the hyperacute forms ending fatally within half an hour from the beginning of the experiment. And concerning the lighter forms, I have observed again all stages from a very mild and transitory œdema, with little congestion, limited to a small area of the gland, up to massive œdema of the whole organ, with intense congestion, small extravasations of blood, and here and there small areas of necrosis of the parenchyma; but all stages of these lighter forms may alike end in recovery, more or less rapid, through subsidence of œdema, reabsorption of hæmorrhagic exudate, and conversion of the small necrotic areas into scar.

Now, is confirmation to be found in the literature? I cannot pretend to have covered the subject exhaustively in my reading, but I have found one

article at least. In the *Deutsche Zeitschrift für Chirurgie*, for 1922, there appeared an article by Zœpfel, the title of which ran thus: "Acute pancreatic œdema as an early stage of acute pancreatic necrosis." Zœpfel points out that the fundamental lesion in acute pancreatitis is the necrosis of the gland tissue, and this is now generally accepted. Early or light cases of the disease are those in which necrosis and possibly hæmorrhage are not only definitely present, but are also in process of further development. Zœpfel here set up a new class upon the basis of an experience of four cases, in which he found a picture which undoubtedly belonged in the rubric of acute pancreatic necrosis, although lacking the basic lesion of necrosis. In each of these four patients he discovered no more than a glassy œdema, which completely infiltrated and enveloped the pancreas, and invaded also the small omentum and the transverse mesocolon. The gland tissue was moderately swollen and hardened, but looked otherwise normal, and in the microscopical sections, which he obtained by cutting out in two cases a small piece of the organ, he was able to demonstrate an entire absence of necrosis, as also of hæmorrhage. In two of these, fat necroses were also found. He goes on to argue that this condition of acute œdema represents the earliest stage of a proper, acute pancreatic necrosis, and, what is more, that the process would infallibly have gone on into a full-blown pancreatic necrosis had he not intervened early. "The discovery of this condition (he says) of acute pancreatic œdema, and above all its successful management, I owe entirely to the principle of immediate operation during the ordinary gall-stone attack." All four patients recovered and all four were operated on within the first twenty-four hours, and indeed three within the first twelve hours. He assumes that his early operation came in time to prevent further progression into the stage of fully developed and possibly widespread necrosis, and he, therefore, demands that operation should be undertaken as soon as there is any suspicion of acute pancreatitis. Suspicion should be aroused immediately whenever, in the course of assumed cholelithiasis, an attack appears in which the most severe pain is found in the middle and left side of the upper abdomen, together with great tenderness and rigidity in this region. In 115 operations undertaken during the acute stage of a gall-stone attack, he found eleven cases of acute coincident pancreatic necrosis, including his four cases of œdema.

The finding of this paper of Zœpfel's was a source of considerable pleasure, for I discovered here the confirmation of my long-held conviction, which up to that time was supported only by the experimental work and the experience of the one case. I take it, therefore, that this picture, both pathological and clinical, may be now accepted as a distinct disease entity. I am under the impression that it is not generally familiar to medical men, but I imagine that nobody will deny its importance. One may contest, as indeed I do contest, Zœpfel's assumption that this pancreatic œdema will go on, usually, into the extremely dangerous condition of widespread necrosis, without thereby diminishing the importance of his observation. A very large number of these œdemas would resolve spontaneously within a few days, if left alone. How

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often have we not seen even more advanced lesions in the pancreas, discovered by chance during gall-bladder operations, recover spontaneously without any such intervention as drainage or tamponing the pancreas! Is this not all the more true of the lighter lesions of pure œdema! By the terms, therefore, of this argument, we are brought back to the conception of a passing pancreatic œdema, caused by the accidental reflux of fairly normal bile into the pancreatic duct, as explaining many of the transient though possibly severe attacks of epigastric pain, often spreading to the left side (though that is not necessary), which are variously diagnosed as indigestion, gastric upset from improper diet, adhesions, ulcer, cholecystitis, appendicitis, or even renal colic. I admit that the diagnosis in such cases must often remain quite uncertain, but I maintain that merely to have in mind the possibility of pancreatic œdema is useful. For it is rather characteristic of this form of pancreatic disturbance that it is apt to be recurrent. The surgeon will not by his training dismiss lightly any complaint of a recurring trouble in the abdomen, which is accompanied by pain, but the general practitioner, familiar as he is with so many pains that come to nothing, and driven by the pressure of practice, is perhaps more apt to do so. Such patients should be thoroughly and methodically examined. Gastric and duodenal ulcer can usually be excluded; likewise, appendicitis. The finding of disease in the bile passages does not exclude, indeed, may rather support, the idea of coincident attacks of mild pancreatitis. In any case let us finish once for all with such vague generalizations as those just mentioned.

But, one may ask, are there no means by which we can attain to greater certitude in the clinical recognition of these cases of pancreatic œdema, or mild pancreatitis? I think there are. Certain clinical signs and symptoms do point to the pancreas. First the situation and character of the pain. A pain which is chiefly felt in the epigastrium and radiates to the left and especially into the left side of the back, while the right side of the abdomen remains comparatively free; and a pain which is of extraordinary severity, is most probably a pancreatic pain. It is commonly believed that the pain of a gall-stone attack often radiates to the left side. That is true, although Katsch and also Westphal deny it. Nevertheless, gall-stone pain is chiefly felt on the right side and radiates to the right shoulder-blade, and only when excessive and at the onset, to the left; it is easy to make sure that its *chief* location is in the mid-epigastrium and to the right. Pain which *persists* in the left side usually indicates a pancreatitis. The location of tenderness is also a good guide, but it is important to use thumb pressure and to work in from all sides toward the pancreatic area, marking the point at which the patient first evinces pain. It is remarkable how often the resulting figure will correspond with the anatomical situation of the pancreas. In some cases one will find an abnormally superficial aortic pulsation, which is most important. In many acute cases, a zone of left-sided hyperæsthesia (Head) is found, and points strongly to pancreatitis. In a gall-stone attack the zone is not found on the left. It was typically present in my case.

Tests for pancreatic function are gaining more favor lately. Wohlgemuth's test for diastase in blood and urine has been employed in a large number of cases in Germany, and is much thought of. Before the war, working with Doctor Bruère, I found that Hewlett's test for lipase in the urine was positive in over half the cases. And of late years the finding of a raised blood sugar is more and more frequent. But it is important that all these tests should be applied early, within the first forty-eight hours; later than that they usually fall out negative. I feel sure that the early generalized swelling of the whole organ is often sufficient to interfere with both internal and external secretions, but the lapse of even two days allows of sufficient reabsorption of œdematous fluid to set free the pancreatic tissue and the excretory paths. Thus then, even in these light attacks of pancreatic œdema, it is possible for the alert clinician to make a very good guess at the true condition. Abnormally severe epigastric pain, radiating to the left; persistent epigastric tenderness on finger pressure, limited to the anatomical position of the pancreas; a Head zone of hyperæsthesia in the left flank at the level of the eighth to the tenth dorsal; a transient hyperglycæmia; a positive test for diastase or lipase in the blood or urine,—all point only in the one direction, the pancreas. And if within a few days all these signs disappear, that very disappearance, corresponding to reabsorption of the pancreatic exudate, is a further link in the diagnostic chain.

Treatment.—The undoubted fact that the condition just described does not often progress to the stage of massive pancreatic necrosis, that it rather tends to spontaneous subsidence, would seem to suggest an expectant plan of treatment, yet the equally well-established fact that any one of these attacks may end in a fatal massive necrosis constitutes a grave warning, and will often justify operation. The diagnosis being established, one should, in my opinion, open the abdomen. When the lesion is apparently due to disease in the bile passages this will itself be a sufficient reason for operation, and the course to be followed is obvious. One will remove stones and drain the bile. With regard to removal of the gall-bladder, so universally, even indiscriminately practiced of late years, my opinion is that in the presence of pancreatic swelling a cholecystectomy is not permissible. With increasing experience we are finding that pancreatitis occurs not infrequently after the gall-bladder, with its valuable safety valve function, has been removed. Von Bergmann estimates the incidence of recurring pain after cholecystectomy at 20 per cent. While this is due in some cases to the fact that a common-duct stone was overlooked at operation, we know that in many other cases this explanation is not applicable, and it is necessary to assume that some disturbance in the peristalsis of the common duct, conceivably a spasm of the sphincter of Oddi, is responsible. It is obvious that such an occurrence would tend to throw bile into the pancreatic duct, and produce a mild or severe attack of pancreatic swelling. Our only safeguard under such circumstances lies in a bile drainage, and if the gall-bladder has been removed the common duct has to be utilized. We must then perform an operation which is tech-

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nically more difficult than a cholecystostomy, and not without danger. If bile drainage has to be maintained for a month or two, as in my opinion it should be maintained, in order to allow time for the pancreatic swelling to resolve, we are faced with the trouble and risk of leaving a tube in the common duct over a long period, with consequent danger of stricture and with, also, whatever danger may lie in the diversion of the total amount of bile to the exterior. Consequently, I do not remove the gall-bladder for cholelithiasis in the presence of pancreatitis, but use it rather for prolonged drainage, which in my experience has been the surest road to cure.

If, on the other hand, no stones are found in the common duct or gall-bladder, and we have to assume a dyskinesia of the motor apparatus of bile excretion, we are at least following the safest course in instituting bile drainage through the gall-bladder, for this provides a safety valve for any transient, increased pressure in the common duct, and thereby tends to prevent a forcing of bile into the pancreatic duct.

In conclusion, therefore, I would urge that operation, under the circumstances described, is advisable, and that it should consist, when the pancreas is found swollen, in a cholecystostomy with bile drainage maintained for a period of one to two months, according to the degree of the pancreatic swelling, giving sufficient time, that is, for resolution of the pancreatic exudate to take place thoroughly.

BIBLIOGRAPHY

- Archibald, Edward: The Experimental Production of Pancreatitis in Animals as the Result of the Resistance of the Common Duct Sphincter. *Surg., Gyn. and Obstet.*, vol. xxviii, p. 529, 1919; Further Data Concerning the Experimental Production of Pancreatitis. *ANNALS OF SURGERY*, October, 1921; Diseases of the Pancreas. Nelson's Loose-Leaf Medicine.
- von Bergmann, G.: Internistisches Korreferat zur Chirurgie des Pankreas. *Arch. f. Klin. Chir.*, vol. cxlviii, p. 388, 1927.
- Katsch, G.: Die Diagnose der Leichten Pankreatitis. *Klin. Wochenschr.*, p. 289, February 12, 1925.
- Schmieden, V., and Sebening, W.: Chirurgie des Pankreas. *Arch. f. Klin. Chir.*, vol. cxlviii, p. 319, 1927.
- Westphal, K.: Experimentelle Untersuchungen Ueber die nervöse Beeinflussung der Bewegungsvorgänge der Gallenwege. *Zeitschr. f. Klin. Med.*, vol. xcvi, p. 52, 1923.
- Zoepffel, H.: Das akute Pankreasödem—eine Vorstufe der akuten Pankreasnekrose. *Deutsch. Zeitschr. f. Chir.*, vol. clxxv, pp. 301-312, 1922.

DISCUSSION

DR. DAMON B. PFEIFFER said that the interdependence of certain inflammatory lesions of the abdominal viscera has long been recognized, especially by the surgeon who sees the forces of pathology in motion. The exact sequence of events, the precise determination of the pathogenesis of these processes, is in many cases not fully settled. This is particularly true of the acute and chronic lesions of the pancreas. Doctor Archibald's long interest in this subject and his contributions to it lead us to receive his findings and opinions with great respect.

It is undoubtedly true that the majority of attacks of pancreatitis at the

present time go unrecognized and misinterpreted. In reviewing the histories of cases of acute pancreatitis, the speaker has been impressed, by the frequency of previous attacks, milder in character but similar in kind to the final and too often terminal one. The failure to recognize the nature of such preliminary attacks finds a ready explanation if not an excuse in the lack of truly characteristic symptoms and signs of pancreatitis, in the absence of definite laboratory or other confirmatory methods and in the frequent preponderating admixture of symptoms of involvement of the biliary tract. Probably the situation will remain unsatisfactory until definite confirmatory methods are devised or until we gain a better knowledge of the true origin and incidence of the disease. Certainly early operations as advocated by Zoepfel would help greatly in unravelling the skein but it seems doubtful whether surgeons can be convinced that early intervention should be practiced in the acute calculous or non-calculous infections of the gall-bladder. Unless the risk of acute pancreatitis is greater than experience seems to indicate, it would seem that the greater risk involved in precipitate operation upon acute biliary disease would more than counterbalance the advantages to the pancreas. Surely Zoepfel's experience in finding 10 per cent. of cases of severe pancreatic disease in a series of a little over a hundred gall-bladder cases is exceptional. However, even without such purposeful early operation, it has fallen to the lot of every active abdominal surgeon to operate upon cases of more or less acute cholecystitis or cholelithiasis and to find the pancreas involved in the process. Allowing for the difficulties and personal equations involved in assessing the differences in size, contour, and consistency which would indicate pancreatic involvement the testimony of many surgeons of large experience and undoubted competence indicates some degree of participation by the pancreas in a considerable percentage of cases even up to 20 or 30 per cent.

Some years ago Arnsperger abroad and Deaver and the speaker in this country advanced the idea that the lymphatics of the head of the pancreas which are known to be in such intimate relation to those of the gall-bladder, liver, and duodenum might be the connecting link. The idea does not lend itself readily to experimental proof or disproof because of our inability to construct conditions comparable to the clinical state of affairs. However, the clinical inferences were attractive and gained some degree of acceptance. Now Doctor Archibald brings us back to the older idea of retrojection of bile and duct-borne infection as the probable explanation of both the acute and the mild and presumably chronic inflammations. It is healthy to have this divergence of opinion, and it is illuminating to see this demonstration and hear his views so ably expounded.

Doctor Pfeiffer has felt for a long time that it is probably a mistake to try to explain too much on a single hypothesis; that the solution probably involves multiple factors. Certainly there can be no doubt of the harmful influence of retrojected, infected bile upon the pancreas. That this can and does occur when a stone of a certain size is impacted in a certain way

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in the papilla of Vater of a certain type of anatomical construction, we know. That pancreatitis occurs without stone is also known. Archibald's experiments upon the cat, however, have shown that the obstruction to the outflow of bile by the sphincter of Oddi may permit the pressure of bile within the ducts to be raised to a point such that bile may be injected backward into the pancreas. This disposes of that objection to the duct theory. But instances of pancreatitis have been reported in which the pancreatic duct did not join the common bile duct but passed directly into the duodenum and at least one instance of acute hæmorrhagic pancreatitis has been reported in an accessory pancreas. Possibly retrojection of duodenal contents may account for the latter cases. There is no way of dodging the incorrigible duct advocate. Those who have seen the œdema and infiltration of the peripancreatic tissue in association with certain cases of cholecystic disease, together with obvious alterations of the pancreatic head, may be pardoned for feeling that infection by lymphatic channels and contiguity is at least a probable factor. Possibly even a rapprochement of the two views may be possible in postulating stasis of pancreatic secretion due to inflammatory involvement of its terminal ducts where they are in close relationship with the termination of the common bile duct and in fact I strongly suspect that such is the case.

In any event the blame is still cast upon disease of the biliary tract. The chief offender is known. The pancreas suffers the frequent fate of the innocent bystander, only we do not know whether the brick was thrown overhanded or underhanded. When we do know, it may help us in the therapy of a not too satisfactory condition. Hence, the great importance of this communication and the necessity for renewed interest and activity in the gathering of data that will help to clear up this debatable point. It is the speaker's opinion that the solution of so-called pancreatitis involves not a single method of pathogenesis but multiple factors as above mentioned and that the apportionment of their relative importance is yet to be made.

DR. J. EDWIN SWEET, of New York, said that he had had some evidence of Doctor Archibald's contention that it is possible to have something less than a fatal pancreatitis. Most of those who have worked with the pancreas were misled by the early workers on the pancreas, who were not surgeons or pathologists, but generally German coroners, whose experience would naturally make them feel that pancreatitis is a fatal disease.

A few years ago in connection with Doctor Krumbaar some experiments were tried with radium emanation tubes in the pancreas. The experimenters found that they could produce areas of typical hæmorrhage of the pancreas. If a sufficient amount of emanation were used, the result was fatal; with fewer tubes inserted into the pancreas the result was not fatal. Doctor Sweet has felt since then with Doctor Archibald that non-fatal pancreatitis, with areas of typical hæmorrhagic pancreatitis, is possible. The speaker asked by just what route Doctor Archibald pictures the passage of this bile from the inside of the duct to the lymphatics in the interacinar

space. It would seem that by way of the duct it should first attack the parenchyma, but in his pictures it looks as if it went into the connective tissue first.

DR. A. P. C. ASHHURST remarked that he should like to know whether this acute œdema which Doctor Archibald describes is an inflammation of the ducts of the pancreas, or a cellulitis, or a lymphangitis. The slides he showed looked like cellulitis. Doctor Pfeiffer spoke of the lymphatics. It seems to me important to decide which it is.

DOCTOR ARCHIBALD closed the discussion of his paper by remarking that he had not intended the paper to be the basis of a discussion on the etiology of pancreatitis and for that reason he had tried to avoid contentious points, but almost inevitably, in any discussion one comes back to the old argument concerning the essential factors of etiology. He can hardly be blamed for being an adherent of the bile retrojection theory in the face of the results he has seen from the direct injection of the pancreatic duct with bile. The connection is so obvious; in animals at least, it is a definite cause and effect sequence, without any chance of mistake. Whether it occurs that way in the human in the majority of cases remains a problem.

Doctor Sweet asked how he explained the transfer of bile, or the bile effect, from the main pancreatic duct and intralobular passages to the stroma. He was speaking, of course, only of œdema. Œdema represents an inflammatory reaction, which invades all the tissues of any organ or any one part of that organ, because it occurs in the vascular tissue which permeates the organ. Irritation of the ducts produces the phenomena of inflammation of which œdema is one of the first and most prominent. It must occur in any or in every tissue, wherever the irritating substance comes into contact with the vascular radicles. The speaker finds no difficulty in believing that an irritant introduced into the duct system, without necessarily penetrating the duct wall, can bring about a condition of œdema in the stroma as a phenomenon of inflammation. More than that he cannot say.

Answering Doctor Ashhurst's question, Doctor Archibald said that he believes it is purely an œdema, inflammatory but not infective like an aseptic inflammation which one may get from the injection of croton oil, but stopping short at the first stage of inflammation which is, let us say, exudation. Whether the irritant gets in by any of the ducts in human cases, we cannot prove. But in animals when he introduced it by way of the ducts, he obtained the appearance shown on the slides. If he introduced infection from outside, say in the gall-bladder, and tried to get the lymphatics to carry it to the pancreas, he was not successful. As to the blood current as a path for the irritant, that is extremely difficult to prove.

DECOMPRESSION OF THE HEART*

BY EVARTS A. GRAHAM, M.D.

OF SAINT LOUIS, MO.

FROM THE DEPARTMENT OF SURGERY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE,
AND BARNES HOSPITAL OF SAINT LOUIS.

DECOMPRESSION has become a recognized therapeutic principle in neurological surgery to relieve the brain of the serious destructive effects of pressure. Similarly the dramatic effects of decompression of the thorax have been noted repeatedly when air has been aspirated from a case of acute tension pneumothorax or when a large collection of fluid has been removed from a pleural cavity. The idea, however, of deliberately attempting to relieve the heart of embarrassing pressure has seldom been proposed, except as it has been applied to the removal of exudates within the pericardium which were causing the condition of so-called "heart tamponade."

The purpose of the present paper is to record two cases in which operations were performed for the deliberate purpose of decompressing the heart. Before giving the details of these cases, however, certain other aspects of the problem should be mentioned. First of all, there is but little information available on what the effects of pressure upon the heart are. This neglected field of study probably offers a rich harvest to those who will carry out properly controlled experiments. Dr. Duff Allen and I are now interested in this problem. So far as I have been able to find there is only a single observation in the literature in which experimental studies have been made of this question with satisfactory control. This was an observation made by Schmitt¹ during the course of some experimental work on partial heart block carried out in the Department of Physiology of the Washington University School of Medicine. He found that a complete block of the conduction of the contraction wave through an isolated strip of turtle heart muscle could be obtained merely by the pressure upon it of a thin strip of rubber dam. If such effects can be produced on a strip of normal muscle, it seems possible that serious effects may follow even less degrees of compression exerted on muscle which is already somewhat compromised by disease.

Normally the heart, enclosed in the pericardium, is partly surrounded by the lungs, which act as two air cushions. This fact might seem perhaps to indicate that nature had made provision against a serious compression of the heart at least from the sides. Moreover, the heart is ordinarily movable to a considerable extent and its mobility affords another possible means of protecting it against serious pressure. Although these protective mechanisms suffice under ordinary normal conditions, yet there seem to be cases in which the heart is subjected to a pressure which appears to be great enough to cause potential harm. These are the cases of children in whom there is a precordial bulging with widening of the intercostal spaces and sometimes apparently a

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pushing forward of the ribs and costal cartilages on the left side. Under ordinary circumstances, in a child the bony thorax grows larger at about the same rate as the heart. However, in a child whose heart is greatly enlarged from rheumatic heart disease, it would seem that the thoracic cage may actually be too small. The heart, moreover, will continue to enlarge because of the demands of mere growth itself. Under such conditions as those described above it has seemed to me that perhaps some relief might be expected from an operation which would diminish the pressure exerted on the organ by the bony and cartilaginous wall of the thorax.

Brauer² in 1902 proposed to Peterson that the third, fourth and fifth left ribs should be removed in a case of chronic mediastinopericarditis in order to permit the heart to contract without the necessity of pulling on the rigid wall of the chest. The operation was carried out with conspicuous success by Peterson, and to it the name of cardiolysis was given by Brauer. The idea, strictly speaking, was not to accomplish decompression, but rather to permit the heart more freedom in action by allowing it to pull against soft yielding tissues instead of against a rigid bony wall. An exhaustive review of all the cases in the literature operated on in accordance with the principle of the Brauer cardiolysis has recently been made by Elsworth Smith and H. S. Liggett.³ In 1907, however, Alexander Morison⁴ of Edinburgh, in ignorance of Brauer's ideas, proposed "the principle of operative interference to relieve intrathoracic pressure when the mere bulk of the heart was the chief feature in the case." After hearing of the successful result in the first case of cardiolysis by Brauer and Peterson he concluded that perhaps the benefit derived from the operation was not entirely to be explained in accordance with the ideas of Brauer, but that perhaps also the factor of actual decompression was important. The following quotation is taken from his article:

"The question arises whether mere bulk is not a disadvantage in these circumstances, and whether, therefore, the justification does not arise for attempting to relieve pressure by the removal of a portion of the ribs and cartilages in the precordia, in obedience to the indications given by the precordial bulging of children, even when it may be assumed that pericardial tethering is absent."

Because of these ideas he persuaded Mr. E. C. Stabb, of Edinburgh, to carry out an operation similar to cardiolysis on a young man, nineteen years of age, whom he had been treating with only moderate success for six years previously for an aortic regurgitation with a greatly enlarged heart. This young man also had very severe precordial pain. The operation was well tolerated, and marked improvement occurred in the patient's condition, with almost a complete disappearance of the distressing pain. A subsequent report⁵ a year later stated that the patient had continued to show improvement and was able to work steadily as a hat maker.

There are possibilities of two kinds of serious compressive effects when a heart is greatly enlarged. One type of these effects is on the heart itself.

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As already indicated above we know very little about the consequences of pressure on the heart itself. The other type of effects is on other intrathoracic structures. We are much more familiar with the effects of compression on other structures than the heart. We know, for example, that the large veins can be rather easily compressed by intrathoracic tumors, by pneumothorax and by large collections of fluid. Still more recently we have learned through the important work of Alexander and Kountz,⁶ of Washington University, that the supposed cardiac decompensation with its attending oedema of the extremities, the enlarged liver, etc., which sometimes accompanies conditions of extreme emphysema of the lungs, is not due to disease of the heart, but that rather it is due to the pressure exerted on the large veins by the greatly distended lungs. There are thus apparent many inviting problems for study in connection with the question of what may happen to a patient from a great enlargement of his heart.



FIG. 1.—X-ray photograph of heart of Case No. 1.

In addition to the type of compression of the heart which arises from its too great enlargement in a restricted bony framework there is also another type in which the heart is squeezed by a pericardium which consists largely of scar tissue. As a result of inflammation the pericardial membrane sometimes becomes converted into scar tissue with dense fibrous adhesions between the parietal and visceral layers. When such a result occurs the action of the heart is inevitably embarrassed regardless of the question of size or of the state of the bony framework of the chest. At times this effect is even greater because the pericardium becomes actually calcified. For the relief of this condition Delorme, in 1895, proposed that in such cases some or all of the fibrous pericardium should be removed. This operation is often spoken of under the name of pericardial decortication. In 1924 he⁷ reported and commented upon two patients that had been operated on by Hallopeau. Sometimes it is impossible to carry out the idea of Delorme because the parietal pericardium is so firmly attached to the heart that it cannot be stripped off. Not only is this true because of calcification which may be present but there are also, occasionally, strands of fibrous tissue which run right into the myocardium from the fibrosed visceral pericardium. Schmieden⁸

has commented on these difficulties after an experience based on eight operations for decortication. He states that it is very important to remove the visceral layer, that is, the epicardium, in order to free the heart properly, and that it is very important to free the left ventricle before the right one. The Delorme operation is rational when it can be carried out and in certain cases the results have been most gratifying.



FIG. 2.—Case No. 1 two months after operation. The forward bulging of the heart is well seen in the photograph.

In this paper I am not discussing the question of a heart that is embarrassed by the contraction around it of a fibrous pericardium. I am discussing rather the question of a heart that may be embarrassed because it is so large that it cannot help being embarrassed by confinement within a bony chest wall. In the two cases reported here the pericardium was not thickened and in the second case it was intentionally opened to permit an inspection of the interior. No fibrous adhesions between the two layers of the pericardium were found, and both layers seemed on inspection to be practically normal. This case, therefore, did not seem to demand the principle of decortication.

I have recently operated on two children for the purpose of accomplishing a decompression of the heart in accordance with the ideas expressed above.

The first patient, E. C., was a boy, fourteen years of age. Since the age of six he had spent most of his time in either the St. Louis Children's Hospital or at its convalescent farm because of frequent attacks of cardiac decompensation. In all he had been admitted to the Children's Hospital ten times in the past eight years. Sometime at about the age of five he had had, apparently, acute articular rheumatism. At the age of six his tonsils were removed and he had had many operations on his nasal sinuses. The patient stated that he stopped with the thirteenth operation on his nose. He has always since the beginning of his illness been very dyspnoëic even on slight exertion. He has been much annoyed by a constant pounding in the precordium and his sleep

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has been seriously interfered with because of palpitation of his heart. Because of having passed beyond the age limit of the Children's Hospital he was admitted to the Barnes Hospital August 27, 1928, with a return of symptoms of cardiac decompensation. Fibrillation which has been noted on numerous previous occasions was present at the time of this admission. There was a diffuse turbulent cardiac impulse extending about two inches outside the nipple. There was an apical systolic thrill and murmur. The rhythm and force of the beat were irregular. The rate was about 150 at the apex and about 120 at the wrist but it was difficult to count. The second pulmonic sound was accentuated. His blood pressure was 105/75. He was discharged on October 4 in compensation after digitalis therapy. He reentered the hospital on October 9 because of a return of some symptoms of decompensation together with vomiting. At this time the only evidence of decompensation, however, was the presence of râles at the base of both lungs. The liver was not enlarged and the peripheral veins not dilated. The fluoroscopic examination showed that both cardiophrenic angles were clear with no evidence of adhesions. The heart shifted readily from right to left with change of position. There was no Broadbent sign. From these findings it was concluded that there was no evidence of a chronic mediastinopericarditis. The question, however, of decompression came up and was discussed extensively with various medical colleagues.

On November 5, with novocaine anaesthesia, the fourth and fifth ribs and costal cartilages, including the periosteum and perichondrium, were removed from the left border of the sternum to the anterior axillary line. The beating of the heart seemed much less restricted than before and the organ immediately bulged forward. The pericardium was not opened but seemed practically normal. The patient went through the operation in a very satisfactory manner, conversing and joking with various members of the operating team during the whole procedure. Immediately before the operation his blood pressure was 135/70. On the following morning it was 130/90; another reading thirty-six hours after the operation also gave the same value of 130/90. The most striking fact about the immediate result of the operation was the very marked subjective improvement. The patient stated immediately that the palpitation and the sense of pounding in the precordium had entirely disappeared. For that reason he was able to sleep much better than before. He was discharged from the hospital in the last week of December. His fibrillation was still present and was thought to be of a permanent nature. Although the subjective result is still excellent the patient has had another attack

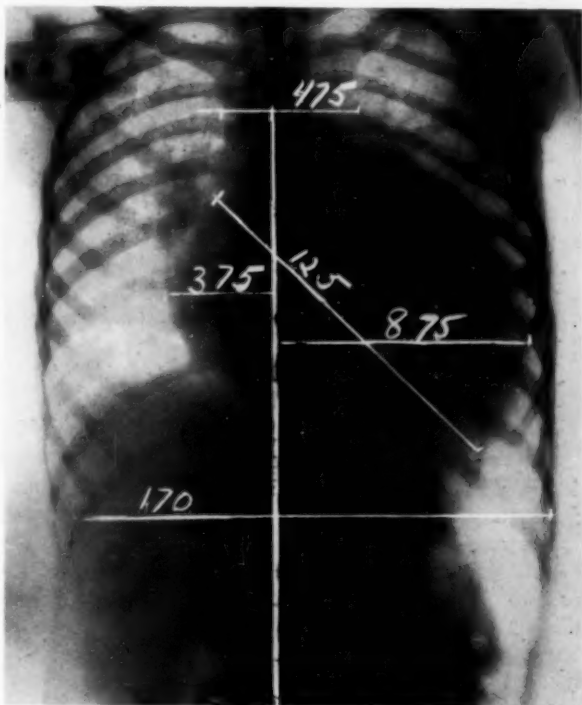


FIG. 3.—X-ray of chest of Case No. 2 immediately after the patient had swallowed barium. Not only is the greatly enlarged heart seen but the deviation of the œsophagus because of the pressure of the heart against it is also well shown. The numbers represent millimetres.

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of decompensation which was thought by his physician to have been due to too much activity. At the present writing he is in Barnes Hospital again with œdema and other signs of cardiac decompensation in addition to some evidence of a pulmonary infarct. However, despite his decompensation he still states that his symptoms are much more easily endured than they were before the operation.

The second case, M. R., a colored girl, five years of age, was admitted to the Children's Hospital December 31, 1928. There had been two previous entries in April and June of 1928 because of cardiac decompensation following several attacks of rheumatic fever. She showed evidence of a mitral stenosis and aortic insufficiency and a myocarditis. There was a marked precordial bulge with a very evident heaving of the whole precordium. The heart extended eight and one-half centimetres to the left; the liver was enlarged. On June 15 and 17 the patient had two sudden attacks resembling acute shock in which the pulse became rapid and thready and respiration rapid and shallow. There was some suspicion that this child had a chronic mediastinopericarditis with fixation of the heart by adhesions. However, about the only evidence of this was that which was presented by an electrocardiographic study of the heart with the technic of Carter and Dieuaide.⁹ There was no Broadbent sign and there was no systolic pull on the diaphragm noted fluoroscopically (Elsworth Smith sign). A swallow of barium showed a marked deviation of the œsophagus to the right. The measurements of the heart on a fluoroscopic tracing were as follows:

Widest diameter of the vessels.....	= 5.4 cm.
Med. Right	= 4.25 cm.
Med. Left	= 7. cm.

On January 23 electrocardiograms showed arrhythmia and intraventricular block. There was also probably a nodal rhythm. There was thus a considerable amount of uncertainty as to whether or not this patient had merely an enlarged heart or an associated mediastinopericarditis. Compensation was restored and an operation was performed January 31, 1929, similar to the one which had been performed on the other patient. A semicircular incision was made beginning at the level of the second rib on the left side curving around the sternum and running backward to the anterior axillary line at the level of the eighth rib. The skin and subcutaneous tissues were turned back in a flap and subperiosteal resection of the fourth, fifth and sixth ribs and costal cartilages was made from the sternum to about the anterior axillary line. The periosteum and perichondrium were also carefully stripped off the pleura. This seemed an important part of the operation because if a permanent decompression is desired it is necessary to prevent regeneration of bone. The pleura was extremely thin and transparent but it was not opened at any place. The pericardium was seen plainly and the pulsation of the heart was regular. The pericardium was opened for inspection. Both layers seemed practically normal and there were no adhesions between them. Decortication, therefore, seemed unnecessary and was not performed. The pericardium was accordingly closed. There seemed to be no very pronounced change in the position of the heart after the removal of the ribs. The operation in this case was performed under anaesthesia with nitrous oxide because this child did not seem to be a good subject for local anaesthesia on account of her great fear of the operation. The operation was well tolerated and it did not disturb the patient appreciably. She was discharged from the hospital on February 19. The subjective improvement in this patient was as great as in the other patient. In addition a striking objective result was obtained. The venous pressure which had been found by Doctor Irvine-Jones to be eighteen centimetres of water just before the operation could not be measured at the time of discharge; in other words this seemed to be very definite evidence that pressure had been removed at least from the large venous trunks. The mother has been greatly pleased with the results of the operation, particularly with reference to the greater ability of the patient to sleep because of the absence of the complaint of too violent pounding in the precordium. The

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mother also states that for the first time in more than a year the child is able to sleep without a pillow under her head. The nodal rhythm had also disappeared at the time of discharge.

Both of the two cases obtained marked subjective improvement from the operation. The second case, in addition, apparently obtained very definite objective improvement as shown by the disappearance of the raised venous pressure and of the nodal rhythm. In neither case were the ordinary indications for the Brauer operation of cardiolysis present, such as positive evidence of a tethering of the heart by adhesions. For this reason, therefore, the beneficial results seem to have been due entirely to the effect of a decompression. The return of a decompensation in the first case was of course disappointing, but too much cannot be expected as a result of the operation. For after all one cannot provide a new heart. Despite the recurrence of his broken compensation this fourteen-year-old boy has steadfastly claimed that he feels much better than before the operation and that he regards the operation as having been distinctly worth while. The second patient has remained entirely compensated since the operation, now about three months. During this time also she has been much more active at home than would have been considered advisable.

In reporting these two cases in which a deliberate attempt was made to decompress a large heart it is fully realized that one must be cautious in the evaluation of the results, in fact that, perhaps, it would be unwise to draw any conclusions in the brief time which has elapsed since the operations except that certain striking immediate effects were produced. The operation itself seems to be associated with practically no danger. There would probably be at the most only a few cases in which the procedure would be justified. Those

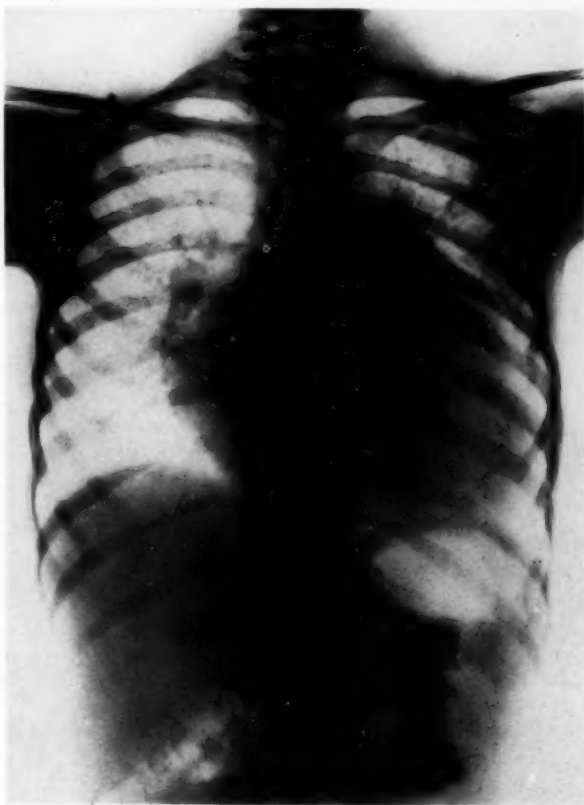


FIG. 4.—X-ray of chest about six weeks after operation and again after a swallow of barium. Although the oesophagus is still deviated to the right the amount of deviation is less than before operation. It would seem, therefore, as if the simple decompression relieved somewhat the pressure of the heart on the oesophagus.

apparently would be for the most part children who had a definite precordial bulging with a large heart. Perhaps when more is learned about the effects of pressure on the heart, other cases in which the indications mentioned above may not be present may be regarded as suitable for decompression; on the other hand, perhaps the operation will be found to be of no special value.

NOTE.—It is unfortunate that after the presentation of this paper both of these patients described above died.



FIG. 5.—Photograph of patient about two months after operation. The marked anterior bulging of the heart is noticed.

In the first case the fourteen-year-old boy, as noted in the article above, was readmitted to the hospital five months after the operation because of another attack of cardiac decompensation with evidence of a pulmonary infarct. Death occurred on the evening of April 23. The post-mortem examination performed immediately afterward showed extensive œdema of the lower extremities, the scrotum and the forearms. When the thoracic cavity was opened both pleural spaces were found obliterated in their lower portions by dense fibrous adhesions. There was also some evidence of a more recent pleurisy in process of becoming organized. Pocketed among these various adhesions were small fluid accumulations. The pericardial cavity was entirely obliterated by dense fibrous adhesions which bound the two pericardial surfaces very firmly together. The heart was tremendously enlarged and the chambers markedly

dilated. The adherent pericardium was attached to the anterior thoracic wall and the apex of the heart was pointed in the region of the resected ribs. The mitral valve was greatly thickened and scarred and its leaflets shortened and contracted. The free margins were thick, tough and inelastic. The leaf on the right side of the valve was especially eroded and contracted until only a thin shelf of the original valve leaflet remained. The chordæ tendineæ were greatly thickened, somewhat shortened and were inserted immediately into the free margin of the valve. Distributed along the edge of this valve and extending for some distance down on the chordæ tendineæ were small raised wart-like vegetations characteristic of rheumatic verrucæ. The wall of the left auricle above the mitral valve was scarred and in some places calcium had been deposited in these accumulations of fibrous tissue. The tricuspid valve showed chronic changes but to a less degree than the mitral valve. However, on this valve were

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small verrucae. The aortic valve showed no changes and seemed competent. The pulmonic valve also showed no change. In the myocardium were small, fine, grayish lines running along the muscle bundles, presumably deposits of connective tissue. The coronary vessels seemed normal, the lungs showed an extensive œdema. In the lower lobe and in the right upper lobe there was a large red infarct, in the right lower lobe there was apparently an older lesion of some type which was gray instead of red. There were some old caseous and partly calcified tracheobronchial lymph nodes. The liver was enlarged, weighing 1460 grams. It showed passive congestion and œdema.

In view of the post-mortem findings in this case it is doubtful if any operation could have had much permanent benefit. It is possible, however, that the patient might have been more greatly improved if an extensive removal of the pericardium had been undertaken in order to accomplish a decortication of the heart.

The second patient, the girl five years of age, was readmitted to the Children's Hospital April 18, with signs of consolidation of the right lower lobe, fever of 103 and 104, pulse of 160. The heart sounds were the same as on previous admissions. No pleural or pericardial friction rub was heard. A diagnosis was made of right lower lobe pneumonia. There was no evidence of cardiac decompensation and the venous pressure which had been markedly elevated before the operation was not sufficiently elevated to permit measurement at the time of this last admission. The child was placed in an oxygen tent but no improvement resulted and she died on April 23. At the post-mortem examination a few fibrous adhesions were found between the parietal pericardium and the chest wall at the site of the operation. The heart was much enlarged and the apex extended below the base of both lungs for a distance of three or four centimetres. On opening the pericardial sac the pericardium was seen to be smooth and glistening with no adhesions between the two surfaces. There was present the usual amount of pericardial fluid. The heart weighed 220 grams; its measurements were as follows:

Mitral valve	8.0 cm. in circumference
Tricuspid valve	9.0 cm. in circumference
Aortic valve	4.0 cm. in circumference
Thickness of left ventricle	1.2 cm.
Thickness of right ventricle	0.5 cm.

Over the left cardiac surface there were a number of irregular fibrinous plaques. The myocardium was of a uniform red color, the musculature appeared normal. The mitral valve was markedly thickened at its margin by fibrous tissue. The papillary muscles of the mitral valve were much hypertrophied and the chordæ tendineæ were shorter than normal. The aortic valve appeared normal as did also the pulmonary valve. The margin of the tricuspid valves was moderately thickened, no fresh lesions of endocarditis could be found. The coronary arteries were patent and the aorta seemed normal. Both lungs showed large areas of consolidation. The pleural surfaces over these areas were covered with a thin fibrinous exudate. Purulent exudate was squeezed from the bronchi. There was no evidence of cardiac decompensation in any of the organs examined.

In this case the principal lesion at the time of operation seemed to be a very large heart with an old disease of the mitral valve. Very marked immediate benefit apparently resulted from the simple procedure of decompression. This benefit apparently was maintained and the death seemed to be an accidental one from an acute infection of the lungs which had no bearing on the cardiac condition so far as could be judged by the post-mortem examination. In spite of the death of this patient three months after the operation there seems to me to be a sufficiently beneficial result as to justify the performance of the operation in this sort of a case.

EVARTS A. GRAHAM

REFERENCES

- ¹ Schmitt, F. O.: Conduction in Depressed Cardiac Muscle and its Relation to the Theory of Partial Heart Block. *Amer. Jour. Physiol.*, vol. lxxxv, p. 334, 1928.
- ² Brauer, L.: Die Kardiolyse und ihr Indicationen. *Arch. f. klin. Chir.*, vol. lxxi, p. 258, 1903.
- ³ Smith, Elsworth S., and Liggett, H. S.: Cardiolyse for Chronic Mediastinopericarditis. *Proc. Interstate Postgraduate Assembly of North America*, p. 489, 1928.
- ⁴ Morison, A.: On Thoracostomy in Heart Disease. *Lancet*, vol. ii, p. 7, July 4, 1908.
- ⁵ Morison, A.: Further Report on a Case of Thoracostomy for Heart Disease, *Lancet*, 1909, (Nov. 20), vol. ii, p. 1494.
- ⁶ Not yet published.
- ⁷ Delorme, E.: Symphyse cardiaque et cardiolyse (1895-1924). *Bull. de L'Academie de Med.*, vol. xci, p. 663, 1924.
- ⁸ Schmieden, V.: *Arch. f. klin. Chir.*, 1925, vol. cxxxviii, p. 552; also "The Technique of Cardiolyse," *Surg. Gyn. & Obstet.*, 1926, vol. xliii, p. 89.
- ⁹ Carter, E. P., and Dieuaide, F. R.: On Certain Variations in the Form of the Human Electrocardiogram. *Bull. J. H. H.*, vol. xxxii, p. 219, 1921.

DISCUSSION

DR. GEORGE P. MULLER said that he had had no personal experience and in the time he had to look up the subject, he could find nothing which suggested decompression of the heart within the limits laid down in the paper of Doctor Graham. The writer had excluded the Brauer operation for adhesions within the pericardial sac, indicating that in that disease the liability results from the drawing of the adhesions upon the surrounding structures and that by removing the anterior chest wall, one releases the pull. Three years ago in reading and abstracting a paper by Dr. John H. Musser, he noted that of 1700 autopsies 4 per cent. died either directly or contributarily from pericarditis with adhesions. He wondered whether there are not more indications for the Brauer operation. In the American literature there are but few cases reported. Shipley's paper on suppurative pericarditis showed that nearly 10 per cent. had symptoms referable to the adhesions, and mediastinopericarditis after rheumatism is not uncommon. This paper represents something, perhaps only an item, but something in the development of thoracic surgery. Unless one has kept in touch with the literature of thoracic surgery, one can have no idea how it has developed, and, leaving the tribute to the last, the speaker stated that Doctor Graham has been the chief leader.

DR. EDWARD ARCHIBALD said that he remembered very well reviewing the first article of Brauer, in 1903, for a local medical journal and of being intensely interested in it. He has been talking to medical men on occasion for years, and asking them if they did not think that certain of their heart cases should have a cardiolyse. He never found a medical man, until the last year or so, who was willing to look at the question at all from a possible surgical point of view. However, lately in his clinic he has had a young man who has acquired a certain authority and whose mind is open and with him. The speaker has seen two patients in the last year concerning whom they deliberated whether an operation should be undertaken. In one case they decided they might do it, but their intention was frustrated by an attack

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of such serious decompensation complicated by infection, that it became impossible to operate and the patient died not long afterward. In the other they were afraid to operate because of the fact that they did not have the Brauer picture of adhesive pericarditis and mediastinitis. Doctor Archibald was pleased to hear Doctor Graham tell of his two cases, the second one of which was so encouraging, and to learn that the presence of the original picture had not been found necessary for the success of surgical interference.

From his experience in thoracoplasty, particularly in pulmonary tuberculosis, he has learned to respect the heart with the coincidence of a fibrotic lung; it is not safe to uncover it too much. In serious fibrotic cases with great contraction on the left side, the heart may be pulled up so far laterally and posteriorly that a portion of it may be exposed by posterior rib removal, whereby a certain risk is run, in the sense that the heart's action is made more rapid. It is difficult to say whether this result is due to the loss of the support which the heart gradually acquires in its new position from fibrotic contraction; and doubtless there are other factors which enter in, as for instance the tuberculosis. But the speaker has not been able to escape the impression that the uncovering of the heart does contribute to a relative heart failure; he is not able to reconcile these observations, if true, with the good effect obtained by cardiolysis in a condition which is also contractile, indeed he must confess that, in spite of a good deal of reading, he does not yet see his way at all clear in the matter of the indications for cardiolysis. He feels nevertheless, that Doctor Graham's contribution is a valuable addition to the subject, and hopes for the opportunity to study his cases more carefully.

DR. EVARTS A. GRAHAM wished to emphasize one or two things: first of all, that he does not claim any originality for the idea of decompression of the heart. Alexander Morrison, of Edinburgh, in 1907, had in view the same idea which Doctor Graham expressed in this paper.

Regarding Doctor Archibald's remarks; if the speaker understood him correctly, he thinks that after thoracoplasty in cases of unilateral tuberculosis cardiac failure occurs because the heart has been freed from its fibrotic surroundings or rib support. Doctor Graham thinks this is a matter of interpretation and is inclined to disagree with him in his interpretation. In Alexander's survey of the literature on thoracoplasty, of 1100 cases nearly all of the deaths occurring within the first week or so after operation were due to pulmonary edema. It appears that the most common cause of operative death in thoracoplasty is compression, whether of the big veins or of the heart he does not know, but it is compression of a sort we should not get. The fibrous capsule might act as a protection against pressure just as against depression; in the speaker's opinion both effects after thoracoplasty are due to too much pressure and not to the relief of pressure.

He was greatly impressed by what Doctor Muller had to say, namely, there must be literally hundreds of cases even of chronic pericarditis suffering from cardiac decompensation which could be greatly relieved by this simple

form of cardiolysis. This speaker had the opportunity to operate on one such patient, a man who had been totally incapacitated for several months, and who since operation has not missed a single day of work, working ten hours a day; it has been four and one-half years since operation. Answering Doctor Gibbon's question as to the operation described by Doctor Summers, the original operation as first described by Brauer, was for opening the pericardium and separating adhesions; he now advocates merely removal of the ribs and chest wall in order to permit the heart to pull on yielding structures and not on non-yielding ones. Doctor Summers' operation was of the latter type. Dr. Elsworth Smith, of St. Louis, has recently reviewed the entire literature on cardiolysis and he has found seventy-two cases in the literature of the entire world in which cases of chronic pericarditis had been operated on by this method.

Another point probably not made clear is the one which Doctor Archibald mentioned; many cases which could have been benefited by this procedure have been refused the operation because they did not present the clinical picture and were thought therefore not to be amenable to this simple performance of cardiolysis. From the speaker's experience with these two cases, he does not think we need to find a very definite clinical syndrome of chronic adhesive pericarditis in order to give relief by this operation.

THE DEVELOPMENT OF SURGERY OF THE STOMACH

WITH SPECIAL REFERENCE TO THE PART PLAYED BY AMERICAN SURGEONS*

By JOHN M. T. FINNEY, M.D.

OF BALTIMORE, MD.

HISTORICAL studies, always of interest, are profitable in proportion to the open-mindedness of the student. Thus only may he really benefit by the lessons contained therein. The historical approach to the study of any subject is most helpful. To learn what others have thought and done, along this or kindred lines, is both helpful and illuminating, as well as saving of valuable time and effort in covering ground that may have been already explored. This fact is well illustrated in tracing the development of surgery of the stomach from the crudeness of the first gastrotomy, as performed by Oriental surgeons, to the fineness of the total resection of that organ as performed today in one of our modern clinics.

In casting about for a subject for my address this afternoon, it has seemed to me that we could, perhaps, spend the time as profitably in this way as in any other. Unfortunately, however, the field is so broad that, in the limited time at our disposal, we cannot attempt to do more than touch the high places. What we shall have to say must, of necessity, therefore, be sketchy in the extreme. In the preparation of this brief historical review, we have been both interested and gratified in tracing the important part played by American surgeons in the development of surgery of the stomach. As Americans, we may well be proud of the contributions made to this branch of surgery by our fellow countrymen.

Philadelphians will, I am sure, be quick to claim the credit due for the pioneer work done by the great surgeons, past and present, whose names have added lustre both to their fair city and to the medical profession.

References to surgical procedures upon the gastro-intestinal tract by early medical historians are meagre. Hippocrates, Aphorism No. 18, states, "a severe wound of the bladder, of the brain, of the heart, of the small intestine, of the stomach and of the liver is deadly." While this statement clearly shows that even at this early date, along with wounds of certain other viscera, wounds of the stomach were already differentiated and their seriousness recognized, yet we have no definite knowledge as to how they were treated. Galen, in commenting upon this Aphorism, makes the statement that "it is said that some wounds of the stomach have been observed to heal, though seldom indeed."

Celsus refers to the use of the suture in wounds of the large intestine, but does not mention its use in either the small intestine or stomach, probably

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simply an oversight. Fallopius recommends for use in suturing wounds of the stomach linen or silk thread, and the continuous suture. Ambroise Paré, among others, also refers in his writings to intestinal suture. It thus appears that suture of the hollow viscera, even at a very early date, was a recognized surgical procedure. From the absence of any direct evidence to the contrary, it is quite probable that the wounds of the stomach, for which suture was recommended, were of traumatic origin rather than those purposefully inflicted by the surgeon.

The earliest definite references to surgical operations upon the stomach that I have been able to find are contained in "La Grande Chirurgie," by Guy de Chauliac, written in 1363. He writes as if the operation of suture of the stomach were already a recognized procedure. The following quotation would seem to justify this assumption: "In a penetrating wound of the abdomen in which the internal parts are wounded and do not protrude, if the said wound suffices, or, if it does not suffice, it may be extended with a suitable instrument, to be described later, they, *i.e.* the wounded internal parts, may be discreetly drawn outside. And if they are in need of suture, and if it profits them, as in wounds of the fundus of the stomach and large bowels, they may be sutured with the glover's suture, and not with the heads of ants, as recommended by some experimenters." With reference to the latter interesting and somewhat novel method of suturing the stomach walls, Gurlt, quoting from Leclerc's translation of Albucassis' "Surgery," written about the beginning of the tenth century, has this to say: "Ants with large heads are used; the edges of the wound are united and the head of the ant applied with the mouth open, to the lips of the wound. As soon as the ant has closed its mouth by closing the mandibles, the head is cut off and remains permanently attached. Others are applied, according to the extent of the wound. The wound is then reduced and a suture is applied to it. Now these heads remain adherent to the intestine until it has healed without causing any inconvenience to the patient." He goes on further to say: "The intestines can also be sutured by means of small filaments which are detached from the intestines of animals, on which they are superimposed. They are threaded in the needle in the following fashion: one of these filaments is seized and is disengaged with care; it is knotted with the end of a linen thread, fine and twisted, with which a needle is armed and the intestine sewed up."

In this single paragraph, reference is made to the early, perhaps, the earliest, beginnings of three important technical procedures in surgery, namely, the heads of ants, a forerunner of metallic clips; absorbable animal tissue as a suture material, from which comes catgut, kangaroo tendon, facial strips, etc.; the silk or linen guide, so widely used, especially by the ear-gynecologists for the easier introduction of the larger sizes of catgut then in vogue.

The first reference to a definitely planned operation, other than the suture of an accidental wound, that I have been able to find is that reported by Gunther in his classical work on surgery. He quotes Crollius, who reports

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the case of a peasant, thirty-six years old, who practiced jugglery and was in the habit of concealing a horn-handled knife in his throat. In the course of such a manoeuvre, the knife slipped down into his stomach and remained there for seven weeks. After plasters and other means of treatment had been employed (among them a magnet to the stomach region) the point of the knife began to cut its way through the abdominal wall. At his urgent request, Mathis made an incision and extracted the knife. The date of this operation was 1602. The knife was nine inches long, entirely rusted, and was said to have been preserved as a curiosity. The patient recovered. Numerous references to this case, which appears to have been quite celebrated, are to be found in the literature.

Again, in 1743, in the *Memoirs of the Royal Academy*, is to be found the report of a woman who, wishing to induce vomiting, inserted the handle of a knife into her throat. The knife, about seven inches long, slipped from her grasp and entered the stomach. After three days, she began to feel pain. On the eleventh day, the surgeon made an incision in the left hypochondrium, where the point had pierced the abdominal wall, and removed it.

Baron Larrey, in his *Memoirs*, reports that while a student at Toulouse in 1780, he was present when Doctor Frizac removed a piece of knifeblade from the stomach of a man. The patient recovered.

Other similar cases are to be found scattered through the literature; in fact the early history of surgery of the stomach seems to be confined to the relation of cases of suture of accidental wounds or the removal of foreign bodies, principally knives. The surprising thing about it all is the large percentage of recoveries among the cases reported. Can it be true of ancient, as well as of modern surgery, that the successful cases seem, somehow, to find their way into the literature with greater facility than the unsuccessful ones?

Apparently, the first American operation upon the stomach, the suture of a stab-wound of that organ, is recorded by John Archer, *Medical Repository*, New York, 1812. This case is one of considerable interest, for several reasons: (1) It was reported by John Archer, of Harford County, Maryland, who was the first to receive a medical degree in this country. He was graduated from Princeton College with the degree of A.B. in 1760, and was a member of the first class to graduate in medicine from the Philadelphia Medical College, the forerunner of the University of Pennsylvania, in 1768.

In the year 1837, Egeberg, a Norwegian Army surgeon, in a lecture before the Medical Society of Christiania, first recommended, as a justifiable procedure, the establishment of a permanent fistulous opening in the stomach through the abdominal wall, to which operative procedure the name of "gastrostomy" was given nine years later. The idea of establishing a fistulous opening into the stomach was suggested to him while studying a case of carcinomatous constriction of the œsophagus which had resisted all the usual forms of treatment. In justification of his position, he quotes cases in which individuals had sustained traumatic fistulæ of the stomach for varying terms

of years, without especial trouble. He referred particularly to the epoch-making case of Alexis St. Martin, studied by Beaumont and reported by him in 1826.

Egeberg (1837), in discussing the subject of treatment of inoperable stricture of the œsophagus, asks the significant question, "Can nothing be done except feeding by rectum for such a case?" He suggests œsophagotomy for strictures high up, and gastrotomy for strictures low down. In discussing this latter proposition, he enunciates the principle, just as true today as then, namely, "that the permissibility or non-permissibility of an operation depends upon the degree of sound probability that the operation will bring the desired result." He calls attention to the fact that hitherto the operation had been done only in order to remove foreign bodies. He recommends preliminary suture of the parietal and visceral peritoneal surfaces, in order to form protecting adhesions and prevent extravasation. "I cannot see why," he adds, "the indications should not be just as great to open the intestinal canal to put nourishment in as it is to open it to take a foreign body out." His logic is as convincing as his judgment was sound. He concludes his thesis by saying, "It all goes to prove that the stomach is not a *noli me tangere*."

In 1846, Sédillot reported to the French Academy of Sciences the results of some operative experiments that he had made upon dogs. For this procedure, he first suggested the name of "*gastrotomie fistuleuse*." He reported three dogs upon which he had performed this operation with complete success. In a later communication he reported more in detail upon the same subject, discussing the indications for and against the operation, and proposes the name "gastrostomy," which has since been generally accepted by the profession.

Again in 1849 the same author reported the first case of gastrostomy deliberately planned and performed upon a human being. This patient, unfortunately, died a short time after the operation. Nothing daunted, four years later, he again operated in a similar manner, with the same result. Nevertheless, he predicted that "gastrostomy," in properly selected cases, is destined to enter definitely into the domain of practical surgery, a prophecy long since abundantly verified.

Fenger, of Copenhagen, was the second surgeon to perform this operation in 1853, independently of Sédillot, and after extended experiments upon animals.

In view of the continued agitation by misguided and fanatical antivivisectionists, it is interesting, indeed impressive, to note the early important part played in the development of surgery of the stomach by animal experimentation. Again and again, in reading over the reports of the work of the pioneers in gastro-intestinal surgery, one finds records of preliminary operations upon animals, indicating that many of the advances were based upon scientific experimentation and not the result of mere haphazard chance. Zesas, in his monumental work, calls attention to the fact that this period of the early forties was quite fruitful in experimental research along these

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lines. He refers to gastrostomies performed upon animals by Blondlot, Bassow, Bardeleben and other surgeons.

In this country, Watson, of New York, in 1844, discussed the question of the practicability of gastrostomy. "Having now shown," says Watson, "that wounds of the stomach are far from being necessarily fatal, we may next proceed to show that openings, whether the result of injury or occurring spontaneously, may give rise to permanent fistulous communication between the stomach and external surface of the abdomen, and that such fistulæ may exist for years without seriously interfering with digestion or impairing the general health." In the face of these facts, he unhesitatingly recommended gastrostomy with the view of prolonging life in cases of intractable constrictions of the œsophagus.

The first gastrostomy performed upon man by an American surgeon of which I can find record was by Maury, of Philadelphia, in 1869, (*American Journal of the Medical Sciences*, vol. lix, 1870). It was deliberately planned and undertaken for relief of stricture of the œsophagus, after consultation with the Elder Gross, Pepper, and Weir Mitchell. Notwithstanding the usual fatal result, Maury states emphatically, "so great is my conviction that the procedure is justifiable, and to be regarded as one of the established operations of surgery, that I would have no hesitation in resorting to it in any case of impending starvation from non-cancerous stricture of the œsophagus, provided malnutrition had not reached a stage which rendered the case hopeless, and, I may state, that Doctors Gross, Pepper and Weir Mitchell entertain similar views." Certainly high commendation for any surgical procedure! While, therefore, credit is due to Egeberg, for first suggesting, and to Sédillot, for first performing this particular procedure, they must share with Fenger, Watson and others the credit for having first tested it experimentally and having established it upon a firm scientific basis.

Due recognition should here be given to the epoch-making work of William Beaumont, an army surgeon, the pioneer American physiologist, and to the value of his experimental studies in digestion made in 1822 and first published in 1826, upon the celebrated case of Alexis St. Martin, the French Canadian, to which reference has already been made. Says Sir William Osler: "There had been several cases of artificial gastric fistula in man which had been made the subject of experimental studies, but the case of St. Martin stands out from all others on account of the ability and care with which the experiments were conducted." And he, in turn, quotes Combe, as follows: "The value of these experiments consists partly in the admirable opportunities for observation which Beaumont enjoyed, and partly in the candid and truth-seeking spirit in which his inquiries seem to have been conducted." This work of Beaumont has been the model for all of his followers, antedating, as it does, the epoch-making work of Pawlow, and reflects great credit upon American medicine. All honor to this pioneer American scientist!

In 1810, Merrem, of Giessen, in an interesting monograph, reported

some experiments upon dogs, undertaken in order to determine whether or not extirpation of the pylorus was possible.

It would appear from Merrem's statements that his work in this direction had been stimulated by the report of the experience, to use his own words, of a "certain famous professor, highly respected and renowned among the medical profession in Philadelphia." Unfortunately, Merrem neglects to give the name of this renowned Philadelphia professor, and a diligent search of all available sources fails, so far, to reveal either his identity or the source from which Merrem obtained his information. This is extremely unfortunate, as, apparently, his work on the resection of the pylorus in dogs, done in 1779, antedates by about a century any similar work of which record can be found. To this unknown Philadelphia professor must be given credit, therefore, as the pioneer in this line of work.

Merrem's observation upon the future of pylorotomy based upon his own experimental work, which is reported in full, is of sufficient interest to quote: "That the extirpation of the pylorus can be accomplished with happy results seems to be confirmed by these experiments; nevertheless, experience has shown that it is a very difficult operation."

Reviewing these experiments of Merrem many years later, Langenbeck comments as follows: "To me it is inconceivable that anyone could think of extirpating the pylorus in man, so that it is not necessary to give reasons why this operation can never succeed." He then gives six specific reasons why it cannot possibly succeed, and ends with this significant comment: "I look upon this operation as a quicker method of sending out of this world a man whom it is impossible to save." An instance, of which the history of medicine contains other notable examples, where a celebrated personage has failed to grasp the full significance of the signs of the times.

Billroth was a better prophet, although he had the advantage of a later date for his prophecy. In 1877, he reported the operation performed by him in June of that year, which he called by the name of "gastrorrhaphie." This operation was performed for the closure of a gastric fistula which had resisted all other attempts at healing. Briefly, the operation was the separation of the stomach from the parietal peritoneum, to which it was densely adherent; next, the turning in of the edges of the stomach wound, which were sutured with fine silk, after inverting the edges of the gastric fistula.

In discussing this case, Billroth makes this significant comment: "This rare case should serve as a model for similar cases, and for many additional procedures along the same lines. From this operation to the resection of a piece of carcinomatous stomach, there is only a bold step to be taken, just as Czerny lately took the step from cesophagotomy to resection of a carcinomatous piece of cesophagus." It is here the influence of the Billroth School first began to make itself felt in stomach surgery.

It is interesting to note that preliminary experimental work, with this end in view, had already been done in Billroth's clinic by his assistants, Gussenbauer and v. Winiwarter. Their work, published a year previously, refers

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especially to the possibility of the operative treatment of cancer of the stomach, and dealt primarily with resection of the pyloric portion. They give detailed accounts of their experimental operations upon seven dogs, only two of which survived the immediate effects of the operation. The chief cause of failure seems to have been sepsis. Their work, however, established the fact that such an operation was possible under favorable conditions, and with better asepsis. To quote their own words: "The experiments here reported prove sufficiently that partial resection of the stomach, in so far as its practicability is concerned, does not involve undue difficulties, and the failures are due more to the accompanying circumstances than to the wound as such. On the basis of the experiments herewith reported, we believe that we are justified in proposing to employ partial resection of the stomach in man for the removal of carcinoma of the stomach, which experience has shown is most frequently located at the pylorus." Brave words, these, and advanced for that period, breathing, as they do, the scientific imagination, tinged with the enthusiasm of youth.

At the same time, 1876, Czerny and Kaiser were following a similar line of experimental work upon resection of portions of the stomach in dogs, and succeeded in resecting the entire stomach of a dog, which survived and flourished for five years, his digestion and nutrition seemingly in no way impaired. He was then killed and his stomach examined by Ludwig, the physiologist, who found that a small piece of stomach wall at the cardiac end had been left, which had become dilated, forming a spherical pouch, which was filled with food.

The first resection operation upon the stomach in man was performed in 1879, by no less a person than Péan, the great French surgeon, who did a pyloric resection in an advanced case of cancer of the pylorus. The patient, very weak and emaciated from a practically complete obstruction of some weeks' duration, survived for five days. Péan, in discussing the operation, emphasized the feasibility of pyloric resection as a justifiable procedure, expressing the opinion that such would eventually be found to be the case.

A year later, 1880, Rydiger, influenced, as he states, by the experimental work on animals of Gussenbauer and v. Winiwarter from Billroth's clinic, and that of Wehr, one of his own assistants, and by Péan's case just referred to, performed the second pyloric resection in man. Rydiger's operation did not differ materially from that of Péan, except that he used catgut throughout instead of silk, and he excised a triangular portion of the lesser curvature of the stomach, which defect was closed by an oblique line of sutures, thus lessening the lumen of the stomach to more nearly that of the duodenum. Péan had made a transverse resection of the stomach, and had inserted the duodenum into the lower angle of the stomach incision. This was done in accordance with Wehr's experimental work. The autopsy showed that, macroscopically, the cancer had been entirely removed, and, there were no signs of infection. It was supposed that the case had died of inanition. In discussing his operation, Rydiger comments as follows: "In reviewing

this case, we believe that we are justified in saying that this operation (pyloric resection) certainly has a future. We must not be frightened off by the first failures. First of all, we shall have to discover the earlier stages of cancer of the pylorus, and, for this end, greater certainty in the diagnosis of the very first stages is greatly to be desired. But then there is still much to be done to build up a good and certain technic of operation." "We agree," he goes on to say, "entirely with Czerny, that no one should attempt this operation who has not previously acquired the necessary practice by experiments on the cadaver and on living animals." Wise surgeons, were they not? Many of the principles enunciated by them are just as true today as then, and departure from them is sure to court disaster.

One year later, in 1881, Billroth reported the first successful case of pyloric resection, the third performed on man, also for cancer of the pylorus. In his comments upon the operation, Billroth further establishes his reputation as a true prophet, as well as a master surgeon. "To reassure those who are of the opinion that my present operation is a foolhardy experiment on man is beside the question. Resection of the stomach has been as completely worked up anatomically, physiologically and technically by my students and myself as any other new operation. Every surgeon, who has had experience in experiments on animals and similar operations on man, has reached the conviction that resection of the stomach must and will succeed. To establish the indications and contraindications, and to work out the technic for the widely different cases, must be our next concern, and the object of our further studies."

The name of "Billroth" is inseparably connected with resections of the stomach and pylorus. The two operations that bear his name, Billroth Methods No. 1 and No. 2, or some modifications of them, represent the two types of resection operation generally performed upon the stomach. With these two classical procedures, everyone is, of course, quite familiar, so description of them will be omitted. There are, however, certain difficulties inherent in both procedures that will be at once apparent to the experienced abdominal surgeon. Recognizing these technical difficulties, many modifications of this operation, of more or less merit, have, from time to time, been suggested.

The great name of Kocher is intimately associated with the operative development of this phase of gastric surgery, and the well-known operation devised by him, and which bears his name, has a definite place in surgery.

It would lead us too far afield to discuss the varied and multitudinous modifications of the operation of pylorotomy that have been, from time to time, reported. Suffice it to say that the various methods devised by and bearing the names of Kocher, Mikulicz, Kronlein, Reichel, Polya, Finsterer, v. Haberer, and a host of others, including the speaker, are all of them, in a sense, modifications of one or other of these two methods of Billroth.

To Randolph Winslow, of Baltimore, belongs the credit for having been

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the first American surgeon to attempt a pylorotomy. He resected the pylorus for a case of cancer of the stomach in 1884 (*American Journal of the Medical Sciences*, July, 1884). Unfortunately, the patient survived the operation but a few hours.

Pylorotomy antedated gastro-enterostomy by two years, but the latter, as it has been gradually developed, has largely superseded the former, until it has, perhaps, become the most popular operation upon the stomach.

The name "gastro-enterostomy" was suggested by Wölfler, at that time an assistant in Billroth's clinic, for a procedure first employed in 1881, and reported by him in that year in the *Centralblatt für Chirurgie*.

The operation was performed on a patient suffering from advanced carcinoma of the pylorus. A loop of jejunum was attached to the anterior wall of the stomach. The result of the operation was quite satisfactory. The second case was operated upon by Billroth himself in the same way. This patient developed a persistent bilious vomiting, from which the patient died on the tenth day. The autopsy showed the interesting condition so well known in the earlier days of the operation under the terms of "spur formation," or "vicious circle."

To Ransohoff, of Cincinnati, belongs the credit of being the first American surgeon to perform this operation. His case, carcinoma of the pylorus, was reported in the *Medical News*, November, 1884, and, unfortunately, succumbed in a few hours.

Many modifications of the operation of gastro-enterostomy have been suggested from time to time since Wölfler's original publication, the most important of which, perhaps, is v. Hacker's retrogastric method reported in 1885. The credit for the idea of making the anastomosis on the posterior, instead of the anterior, wall of the stomach has generally been given to v. Hacker. Courvoisier, however, antedated v. Hacker's work by two years, having reported in 1883 a case that he had operated upon in that way. The patient died thirteen days later of a diffuse peritonitis. In discussing the operation, he calls attention to the advisability of identifying the loop of jejunum used for the anastomosis by first finding the duodenojejunal angle, thus avoiding the use of a haphazard loop, a very real and important advance. In anastomosing the loop of jejunum to the posterior wall of the stomach, he made his incision in the mesocolon parallel to the long axis of the colon, rather than parallel to the blood supply, as did v. Hacker later. His patient, too, unfortunately, died, a record that recurs with melancholy frequency among the pioneer cases of gastric surgery. He was the first to suture the edges of the rent in the mesocolon to the stomach wall, another distinct addition to the technic of the operation. In discussing the high mortality rate of this operation, he makes this pertinent comment: "This is easily understood, since inoperable carcinoma is generally the indication for the operation."

Because of the fact that it is such a comparatively simple procedure,

gastrojejunostomy has been at times employed rather indiscriminately and without proper indications.

The operation of gastro-enterostomy, whether performed anteriorly by the original long loop, either with or without some form of supplementary entero-anastomosis, or by the posterior no-loop-gastro-enterostomy, presents certain obvious objections inherent to the method. These are well known to every surgeon of experience, and are responsible for approximately 20 per cent. of unsatisfactory results. A few clinics report a lower percentage of failures, but the average is about as stated.

In order to do away, as far as possible, with these objections, various methods of direct union of the stomach and duodenum have been suggested and practiced by different authors.

To Jaboulay belongs the credit for having, in 1892, first suggested the method of gastroduodenostomy, which he, two years later, performed. He made the anastomosis directly between the walls of the duodenum and the stomach, folding the duodenum over on the anterior wall of the stomach, using the pylorus as a hinge.

Shortly after, Kummel reported an almost identical procedure. Later Villard, in 1897, brought the duodenum and stomach together side by side, and anastomosed the duodenum to the greater curvature of the stomach in what he calls his "subpyloric gastroduodenostomy." In this method, he does not disturb the pylorus at all.

In his original article, Jaboulay directs attention to the prime necessity of mobilization of the duodenum in all operations that have to do with the utilization of this portion of the intestinal canal for anastomotic purposes. Kocher, later, again stressed this point, and my own experience in this particular field has abundantly confirmed his observations. I wish to reemphasize this point, namely, that upon the surgeon's ability to mobilize satisfactorily the duodenum depends, in large measure, the success of all forms of gastroduodenostomy.

Following Jaboulay's lead, many variations of his operation, of more or less merit, have been suggested.

In discussing gastroduodenostomy (pyloroplasty) and its indications and contraindications, Kocher makes the following emphatic statement, which expresses our own conviction in the matter: "Unlike other surgeons who have performed gastroduodenostomy, we do not limit the operation to special cases. On the contrary, we regard it as the normal procedure over all the previous methods,"—certainly high praise from one of the greatest of surgeons.

We have come to this way of thinking because we have found that, after thorough mobilization of the duodenum, one can do almost anything that he wishes with it, excise ulcers situated on either side of the pylorus, in fact, do a virtual pylorectomy through the gastroduodenostomy incision, as first suggested by us many years ago.

Gastrectomy has, from the beginning, held a great deal of interest for American surgeons. The first to perform this formidable operation was

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Conner, of Cincinnati, in 1884, and, of the first dozen gastrectomies performed, six were by American surgeons. In discussing his case, which, unfortunately, died upon the table from shock, Conner says: "I had hoped to be able to get the cardia attached to some portion of the intestinal tract. I did not care much where, so that the fluids poured out into the upper part of the small intestine might flow down to meet the food and cause digestion in that part of the intestine where they came together." He further states that he considered the operation a perfectly feasible procedure.

The first successful total gastrectomy was reported by Schlatter, of Zurich, in 1897. The second successful case was operated upon by Brigham, of San Francisco, in May, 1898.

In a recent monograph published jointly by the speaker and Rienhoff, sixty-seven cases of undoubted total gastrectomy were reported, with thirty-one recoveries; fifty-five cases of subtotal gastrectomy, with forty-one recoveries,—a truly remarkable showing!

In 1910, Payr, of Leipsic, recommended the so-called "sleeve resection," which, as the name indicates, involved the removal of a zone of tissue from the body of the stomach. This method achieved a considerable degree of popularity for a time, chiefly in Germany, but, owing to certain obvious objections, it never came into general use.

Experience has shown that in the "V"-shaped type of resection, the mechanical function of the stomach is more or less seriously interfered with, and emptying of its contents delayed. This, of course, constitutes a serious objection to its extended use.

With regard to the excision of ulcers, as first performed by Rydiger, 1881, other things being equal, it would appear to be advantageous to attack the ulcer directly and extirpate it completely, because there are certain possibilities for serious trouble inherent in an ulcer, namely, perforation; hæmorrhage; deformity from perigastric adhesions; narrowing of the lumen by cicatricial contraction and, lastly, in the malignant degeneration, which, in gastric ulcer is a real possibility. On the other hand, the resection of any considerable portion of the wall of the viscus must necessarily be attended by a certain amount of deformity and interference with function. These factors must all be taken into consideration in deciding for or against resection. It must be borne in mind, too, that even after complete resection of an ulcer, recurrence has been known to take place. Giving due weight to all these considerations, however, the manifest advantages occurring from excision of the ulcer would seem to warrant giving the operation serious consideration where practicable. Some operators make a practice of combining gastro-enterostomy with excision of the ulcer, but this would appear to be unnecessary, except where there is present definite obstruction of the pylorus. Our own practice has always been to excise the ulcer where possible, whether gastric or duodenal, through the gastroduodenal incision, recommended by us over twenty years ago, or to resect the pyloric portion of the stomach in case of gastric ulcer along the lesser curvature, followed by a gastroduo-

denostomy end-to-side, the so-called "Haberer-Finney Method," or by a gastrojejunostomy, after the method of Polya.

Of late, a tendency has been observed, especially in some of the Continental clinics, and in a few in this country, toward massive resection of the stomach in the treatment of duodenal and gastric ulcer. This is but an elaboration of Rodman's idea, enunciated many years ago, of the excision of the so-called "ulcer-bearing area." Unquestionably in certain cases of the indurated type of ulcer, where both the operating surgeon and the pathologist find difficulty in distinguishing it from cancer, wide excision is to be recommended. In fact, when in doubt, it is probably the safer course, in all cases, to practice resection rather than any less radical method. But saner surgical judgment will, I think, not sanction the indiscriminate use of unnecessarily mutilating operations upon the stomach any more readily than elsewhere in the body. Such extensive resection operations, undoubtedly, have their place in surgery, but their use should be restricted for the present, at any rate, until we know a little more surely the ultimate effect of such extreme measures upon the physiology of digestion.

Time would fail us, nor is it the purpose of this paper, to discuss the many interesting problems in the etiology and pathology of ulcer and cancer of the stomach; or, in chemistry, physics, anatomy and physiology that are involved. Our aim has been rather to give a hasty and necessarily sketchy review of the history of the development of surgery of the stomach, in the hope of gaining a wider knowledge of, and a deeper insight into, the mental processes that controlled the pioneers in surgical thought and progress. Much creditable work has not been referred to, not because of lack of merit, but simply because of lack of time. Only those epoch-making contributions have been considered, which seem to have influenced more or less profoundly the historical development of the subject.

In this study, we have been interested in principles rather than methods. It has been a real pleasure to direct attention to some of the many excellent contributions that have been made by American surgeons, and in giving a somewhat tardy recognition to their pioneer work in this particular field.

It is of interest to note the order of sequence in which the various operative procedures on the stomach have been developed: (1) The emergency operations—suture of accidental wounds of the viscus; removal of dangerous foreign bodies that had been swallowed, *e.g.*, knives and other sharp-cutting objects. (2) The stage of deliberately planned operations, those of necessity, for the relief of obstructive symptoms resulting from cancerous growths or cicatricial contractions in the oesophagus or at the pylorus, or for the removal of these growths themselves. Then when more confidence had been gained from experimental study and wider knowledge of physiology and pathology, and with better surgical technic, gradually the field of surgical endeavor has been widened to include ulcer and all of the many sequelæ resulting therefrom. In other words, as in most other departments of surgery, the operations of necessity preceded the operations of choice, but once the principles

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thus laid down by the pioneer surgeons came to be established, further application and development along different lines were not long delayed.

As indicated in the opening sentence of this paper, many useful lessons may be learned from a study of surgical history. Among the more important, perhaps, are, first, in order that a given operation or method of surgical procedure should attain lasting success, it must be based upon correct anatomical, physiological and pathological principles. It must, in addition, conform to certain general laws of practicability and technic, that is, it should be possible of accomplishment with a fair degree of ease, by a surgeon of average skill and ability. Finally, it should yield a high percentage of success, both as regards immediate mortality rate and ultimate functional recovery.

The pages of the history of surgery are covered with the records of operative procedures without number that, like Jonah's gourd, flourished vigorously for a time, but, when the pitiless rays of criticism and experience beat down upon them, like the gourd, they withered, because they were not deeply rooted in the fundamental principles underlying all good surgery. If he would not appear ridiculous, let him, therefore, who would benefit from the lessons of history, before linking his name to a given operative procedure, make sure that it conforms to the above requisites.

Furthermore, it should not be forgotten that all recoveries from surgical operations are not accompanied by complete restoration of function; far from it. It is a sad, and all too frequent, occurrence that a patient may recover from a surgical operation, and not only may be no better, but may even be worse than before. The war has taught us the valuable lesson that the term "recovery" should include function as well as life and that, other things being equal, a recovery from a surgical operation that does not carry with it restoration of function and the ability to enjoy life and earn a living, is hardly worthy of the name.

Applying these historical tests to the many and various surgical procedures that have been brought forward in the past comparatively few fruitful years of the development of gastric surgery, it will be readily seen why so many efforts in this direction were still-born, and why yet others failed to survive early infancy, leaving nothing but their memories behind. Changing the metaphor, they were sown in shallow ground physiologically, pathologically and surgically, and hence quickly withered and died. On the other hand, while there may be an occasional exception to this rule, it will be found that those methods that have stood the test of time and experience and that continue to yield the best functional results, with the lowest mortality rate, are those that most nearly conform to the fundamental principles of good surgery, which, in this presence, it is unnecessary to enumerate.

Let me repeat, in the last analysis, the acid test of every surgical procedure is the ultimate result in terms of restored physiological function and slight immediate risk to the life of the patient. The attainment of this goal should be the constant aim of the surgeon.

Every case that comes to the surgeon presents a problem which should

be studied and decided, upon its own individual merits, and not by a process of generalization or by custom or habit, as is too often the case.

The surgeon's problem is twofold, diagnosis and treatment. The former may be established only after careful, perhaps prolonged, study of the case. The services of a competent internist may here prove most valuable. At times a positive diagnosis may not be possible without an exploratory incision, and, rarely, not even then. After the diagnosis has been made as nearly as may be, it becomes a matter for mature surgical judgment, not routine, nor habit, nor fashion, to decide what is the surgical procedure that is most likely to give the best result in the particular case. Personally, the speaker has long since abandoned the pernicious habit of deciding beforehand what he will do in operating upon a given case, for each should be a law unto itself. In one case, one surgical procedure will be found to adapt itself best to the conditions present, while, in another case, another method will surely yield a better result, and the patient should always be given the benefit of the choice, and that method of operation which most nearly complies with the conditions found, other things being equal, should be given the preference. It is bad judgment and worse surgery to push the use of any operative method beyond its anatomical and physiological limitations. By so doing, the surgeon but courts disaster.

When these fundamental principles of surgery, abundantly established as they have been, both historically and by the combined experience of leading surgeons everywhere, come to be thoroughly understood and more generally observed, much of the present dissatisfaction with the end results of surgery of the stomach, upon the part of both patient and surgeon, will happily disappear.

DISCUSSION

DR. J. STEWART RODMAN said that since there is nothing to be added from the historical viewpoint it seemed that he might best use the time allotted in an attempt to briefly appraise some of these procedures from the standpoint of their ready usefulness in the clinic of an average worker in one of our larger centres.

The very fact that there is such a wide choice of procedure makes the problem somewhat difficult. It has seemed to the speaker that those of us who, even with several hospital appointments, have clinics of only moderate size will do well to limit the choice of operation to a comparatively few well-tried procedures and to leave to our larger clinics, with their vast array of cases, the broader field. This choice must of necessity, however, include a sufficiently broad field to cover the important necessities for management which arise for any surgeon who is qualified to handle gastric surgery.

In the first place, we are all called upon to handle the acute emergencies and should have a definite plan therefore of handling hæmorrhage, gastric or duodenal, or perforation of the stomach or duodenum. Hæmorrhage will often respond, in fact usually, to medical treatment, and it is essential

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to closely coöperate with the medical side in this matter as indeed in all others when undertaking the management of any gastric lesion. Usually rest in bed, morphia, restriction of diet and an ice-cap locally will suffice. If hæmorrhage is repeated the introduction into the stomach through a tube of hot water at 120° will sometimes check the bleeding. It is necessary, of course, that transfusion be done at times but this should be guardedly done as active bleeding may be thus started up. Lastly we will be called on, although infrequently, to directly check the bleeding by operative measures and then there is nothing to do but gastrotomy with direct ligature of the bleeding point. Whether or not gastro-enterostomy should be added to this must be decided by two factors—first, one's ability to find the bleeding point, and second, the condition of the patient and the consequent margin of safety that one is working with in that particular case. Theoretically it is better to do a gastro-enterostomy if possible, especially if the bleeding area be at or near the pylorus.

In dealing with perforations either gastric or duodenal, unless the case be seen very early, say within the first six hours and there has been but small chance for soiling of the peritoneum, the least done in order to save the patient's life the better. Simple closure by purse string of the perforation reinforced by an omental tag, has been the speaker's choice in most cases. In a few cases where the perforation is duodenal and where the patient was seen early, he has been influenced by the teachings of Doctor Deaver who has had such a large experience in gastric surgery, and done a gastro-enterostomy as well. Undoubtedly there are times when ulcer symptoms will recur after the simple closure of a perforation, but one must assume this risk realizing that, in emergencies particularly, surgery must be life-saving first and ideal afterward.

When these emergencies do not exist and after the patient with gastric or duodenal ulcer has had more than a reasonable trial at cure by medical means, the judgment of a surgeon will often be taxed as to what operative procedure will best fit the given case. This problem is simplified somewhat in the case of duodenal ulcer. Doctor Rodman believes that surgery should not play a very large part in such cases. Most duodenal ulcers will heal under careful dietary restriction and other medical means. If symptoms persist in spite of such management a gastro-enterostomy either alone or, preferably, in combination with infolding of the ulcer will cure the majority. In handling gastric ulcers, however, the choice of procedure is much more difficult. Recent advances in pathological and physiological knowledge together with the wide choice of excellent technical procedures have made this so. There are, however, certain principles which one must adhere to. The first of these is excision of the ulcer if at all possible, whether one does this by direct excision with the knife or by Balfour's cautery method matters little. In addition to such local excision one should overcome the pylorospasm in these cases by doing gastro-enterostomy or pyloroplasty by either the Finney or Horsley technic.

As might be expected the speaker is a believer in the principle of pylorectomy for ulcer since his father believed so firmly in this principle and was the first to suggest it in 1900 in a paper read before the American Surgical Association. He believed this the logical thing to do because at that time most ulcers were thought to be in the pyloric zone, and the majority thought that the instance of the development of carcinoma from ulcer was high. We now know that the majority of gastric ulcers are situated along the lesser curvature and we believe that only a small number of gastric cancers have their origin in ulcer. While these reasons, therefore, cannot carry as much weight as then, the very fact that accumulated experience has shown that permanent cures are much more apt to follow pylorectomy than gastro-enterostomy is sufficient reason in itself for continuing this principle in preference. Also, there can be no reasonable doubt that while cancer does not develop on ulcer nearly so frequently as was formerly thought, malignant degeneration will occur at times. The work of that excellent pathologist, Doctor M. J. Stewart, of Moynihan's former clinic in Leeds, which shows that about 95 per cent. of ulcers develop into cancer and that some 17 per cent. of already developed cancers have their origin in ulcer fairly represents this matter. These figures also about express the average belief of many surgeons who do a considerable amount of gastric surgery. The reasons for preventing subsequent bleeding and perforation from the ulcer base by its complete removal are as sound today as when this principle was first proposed. Pylorectomy for ulcer is unquestionably a more serious operation than gastro-enterostomy and in the speaker's own experience is not as widely applicable as his father thought. In the presence of much inflammatory tissue he has found great difficulty in sufficiently mobilizing the pylorus to make a pylorectomy a reasonably safe procedure. In such cases a gastro-enterostomy will suffice as it is the general rule that when adhesions are too extensive to warrant pylorectomy they are also too extensive for a pyloroplasty. In these cases pylorectomy can follow at a later date, when often, after putting the pylorus at rest as has been done by the gastro-enterostomy, there will have resulted a sufficient quieting of perigastric inflammation to make the mobilization of the pylorus possible.

While a firm believer, therefore, in the principle of pylorectomy for ulcer, Doctor Rodman feels equally certain that the present-day enthusiasm on the part of some Continental surgeons and a few in this country for extensive gastric resections for gastroduodenal ulcer will quickly pass. One cannot help but feel that here the cure is worse than the disease and that this drastic procedure is not justified on pathological or physiological grounds.

In reestablishing the continuity of the gastro-intestinal tract after pylorectomy or partial gastrectomy Polya's operation as modified by Balfour seems to be an improvement on the Billroth II. It is time conserving certainly, and where it is necessary to remove a fairly large part of the stomach gastro-enterostomy is made most difficult. The speaker must

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confess, however, to an entire satisfaction with the Billroth II technic in the average pylorectomy.

His experience with pyloroplasty has been so limited as to hardly warrant the expression of an opinion of its value. Certainly Doctor Finney has enormously improved on the original Heineke-Mikulicz technic and in his hands it has a definite field of application with excellent results. One of the many reasons, however, why all of us recognize in Doctor Finney the surgical master is that he possesses to an unusual degree that most admirable of traits, surgical judgment. Therefore, one feels sure that, in his hands, pyloroplasty is only done when it serves the particular case better than any other method. Gastro-enterostomy either alone or in combination with local excision remains a useful operation. It is curative in duodenal ulcers and serves a useful purpose in those cases of carcinoma of the pylorus where radical removal is impossible and yet obstruction to the pylorus has developed. It is true that the serious matter of gastrojejunal ulcer will develop in the stoma at times but taking it by and large, gastro-enterostomy has been responsible for much relief from symptoms and many permanent cures.

DR. JOHN SHELTON HORSLEY, of Richmond, Va., said that Doctor Finney's emphasis upon the necessity of following the results of a physiological as well as a pathological study of the stomach is important. The physiologic work of Cannon, Carlson, Luckhardt, Dragstedt, Kline and others has really formed a basis for our modern gastric surgery.

The physiology of the stomach may be divided into three general classes: First, the digestive function; second, the motor function; and third, the function of absorption. It seems necessary to keep these different functions in mind in order to reconstruct the stomach in such a manner that after the pathology has been removed or corrected its gastric physiology will be restored to normal as far as possible. There are several different operations on the stomach which may be indicated in different lesions. The surgical technic should be made to fit the pathology that is present, instead of attempting to stretch one surgical procedure in order to cover every lesion. When there is a small ulcer about the duodenum with but little surrounding infiltration and few if any adhesions, a pyloroplasty often gives excellent results. When the lesion of the duodenum is extensive and infiltrating, a gastro-enterostomy is usually the best procedure.

Gastro-enterostomy may be unphysiologic, but so is amputation of an extremity. There are very definite indications for both procedures. The tendency to excise a large portion of the stomach for a small duodenal ulcer appears to be a swing to a too radical procedure for the lesion that is being dealt with. It would seem wiser to do a less radical operation for a small lesion with a possibility of a recurrence in a few cases when a more radical procedure can be utilized, than to employ an extensive gastrectomy as a primary operation in all cases.

An absence of acidity following partial gastrectomy is not solely caused by the removal of a portion of the stomach. The pyloric portion of the

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stomach secretes alkaline material, and even if the acid secreting part is removed it does not include all of the acid-bearing gastric mucosa. Partial gastrectomy, or any operation which permits the free reflux of the highly alkaline duodenal contents into the stomach, causes a neutralization of the acid gastric juice. The chief element of alkalinity in the duodenal contents is the pancreatic juice. Any procedure, then, that will promote a free reflux of the duodenal contents into the stomach is likely to be followed by a reduction of acidity. This reduction, of course, is quite different from the achylia found in such diseases as pernicious anæmia or cancer, in which the gastric glands themselves cease to secrete acid, probably due to some toxic influence.

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THE OPERATION FOR UNDESCENDED TESTIS

A FURTHER STUDY AND REPORT

By ARTHUR DEAN BEVAN, M.D.

OF CHICAGO, ILL.

THIRTY years ago at the meeting of the surgical section of the American Medical Association in 1899, I presented a paper on "Undescended Testicle and Congenital Inguinal Hernia," and reported a small group of cases that I had operated upon by a new method which I had devised. This paper was reported in the *Journal of the American Medical Association*, September 23, 1899. The foundation of this work was a method which I had developed for operating on congenital inguinal hernia. It was a very simple matter: the transverse division of the vaginal process about an inch below the internal ring, separating the peritoneum from the cord with great care not to do any injury to the structures of the cord, stripping the upper part of the vaginal process upward to the internal ring and ligating it as we do the sac of an inguinal hernia; then stripping downward from the transverse division of the vaginal process for a short distance and closing the lower part of the vaginal process with a purse-string suture, so as to leave it as the tunica vaginalis of the testis. I thought at the time that the method was original. It is quite possible, however, that other surgeons have independently done the same thing in handling the open vaginal process in their cases of congenital inguinal hernia.

In 1898 I operated on my first case of undescended testicle, which was associated on one side with a well-developed congenital inguinal hernia. The case was a very favorable one for the placing of the testicle into its normal position. Both the hernia and the undescended testicle occupied a position in the groin. In the operation I did as I had done several times before in operating on congenital inguinal hernia: divided the vaginal process transversely, closed the upper end at the internal ring as we do the stump of an inguinal hernia, and then stripped the remainder of the vaginal process which

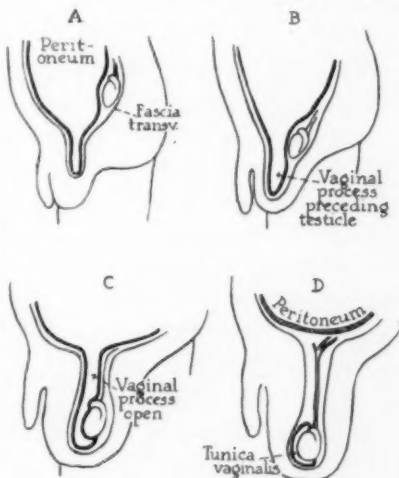


FIG. 1.—The descent of the testis.

was closely united with the cord off from the cord for several inches, and closed the opening in this pouch of peritoneum with a purse-string suture. I found that in doing this I had so lengthened the cord that I could, without tension, bring the testicle down to the middle of the scrotum. I then made

a blunt dissection with my fingers and stretched a good-sized cavity in the scrotum on that side so that I could place the testicle in the scrotum without any tension. I found, however, that in order to retain the testis in the new pocket which I had made, it was necessary to close the neck of the scrotum with a purse-string suture, leaving simply room for the cord, which was behind the suture and, of course, not included in it. I then operated on the opposite side which was not associated with a hernia and found that with the same technic I could close the potential inguinal hernia on that side; free the testicle so that I could lengthen the cord

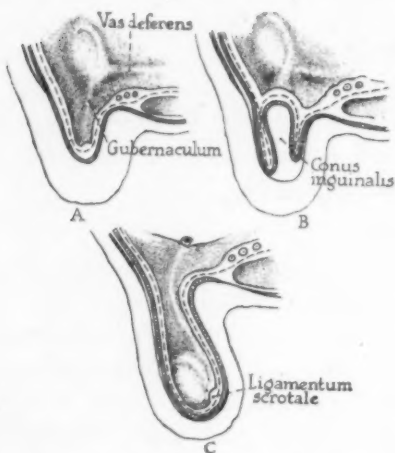


FIG. 2.—The descent of the testis.

sufficiently to bring it down into the scrotum without any tension by stripping the peritoneal process off from the entire length of the cord and dividing some shortened strands of connective tissue in the cord; I then prevented its being drawn upward onto the groin by closing the neck of the scrotum with a purse-string suture of catgut. This was the foundation of the operation for undescended testicle which I have now been doing for thirty years.

Four years later I published a second article in the September 19, 1903, number of the *Journal of the American Medical Association*, on the "Surgical Treatment of Undescended Testicle."

In the meantime I had reviewed the literature very fully and found that a number of surgeons had operated for this condition and that the most valuable contribution up to the date of my first operation was that made by Max Schiiller in 1881, in which he pointed out and demonstrated, at operation, the fact that the most important factor in

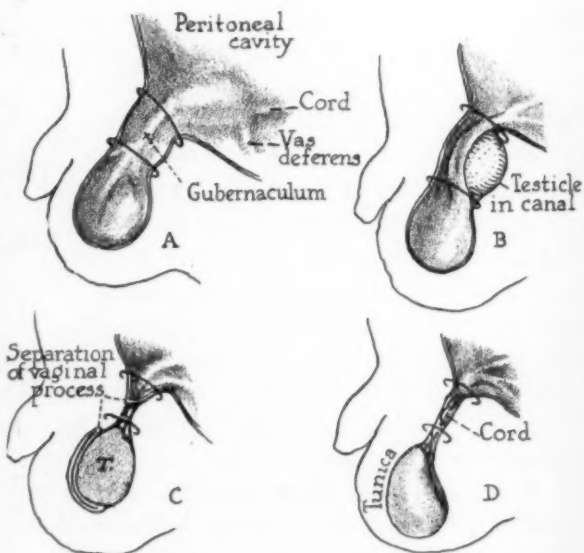


FIG. 3.—The descent of the testis.

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preventing the lengthening of the cord; so that the testicle could be placed in its normal position in the scrotum, was the unyielding vaginal process of peritoneum. Max Schiiller found, as I had done, that this vaginal process of peritoneum was unyielding from the standpoint of lengthening it in any way. The peritoneum is very pliable; it permits of a very wide range of motion from side to side but is very inextensible. The contribution of Max Schiiller was a most valuable one, but he did not develop the further necessary steps to bring the operation to a complete and successful conclusion. He stitched the testicle to the scrotum in order to

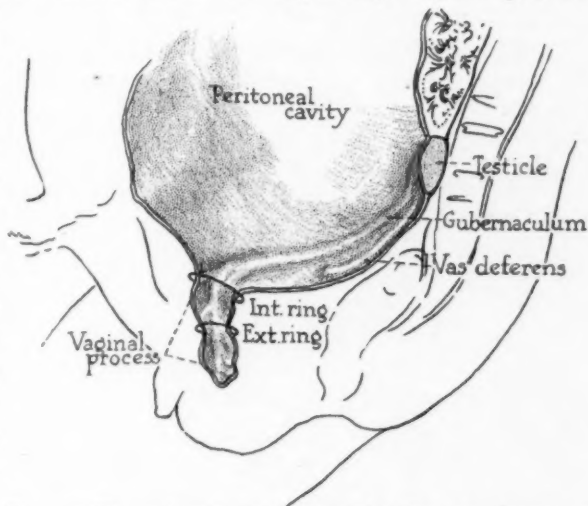


FIG. 4.—The peritoneal process formed before the descent of the testis.

prevent retraction which, of course, was of no value.

In 1904 I published this work in Langenbeck's *Archives*, vol. lxxii, 1904. In 1906 I published this operation in Keen's *Surgery*. In the *Surgical Clinics*, of Chicago, December, 1918, after a larger experience with the operation I again presented the subject fully.

We have now had in my service a long and a large experience with operations for undescended testicle, and I desire today to review this subject and bring it up to date because I feel that the results which we

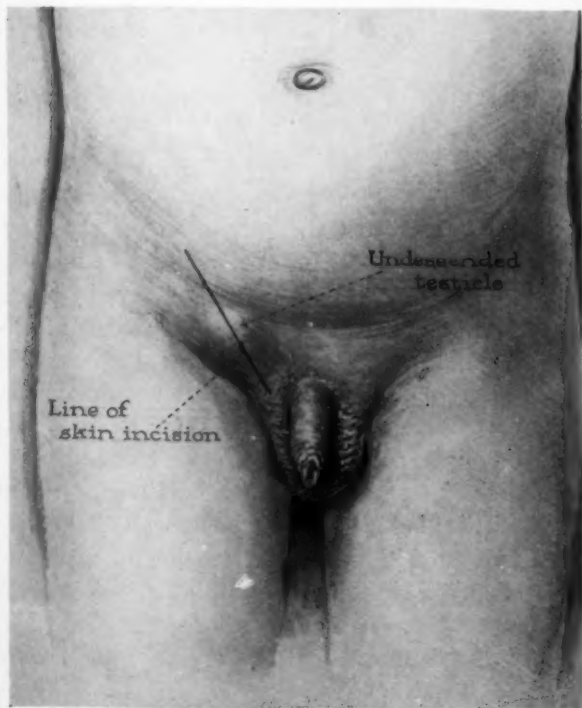


FIG. 5.—The skin incision.

have obtained, and which we can now obtain by this method, warrant its general adoption. During the thirty-years since my first paper in 1899, a

a great deal of work has been done on this subject by many surgeons in many countries. Many different methods have been employed, and the results of these methods reported. Many of the methods suggested, such as stitching the testicle into the scrotum or to the thigh and plastics on the scrotum, are unsound and unscientific, and a great deal of confusion has arisen in

regard to this whole subject. There has developed out of all of this work a thoroughly sound and scientific method of operating for undescended testicle which is based upon simple, clear, definite anatomical, physiological and surgical principles, quite as simple and definite as the principles underlying our modern radical operation for inguinal hernia, or the Rammstedt operation for congenital pyloric stenosis. Before presenting the operation in detail I desire to draw briefly a picture of the condition. Undescended testicle occurs in about one out of five hundred males as shown by physical examination of recruits for the army in countries where compulsory army service has

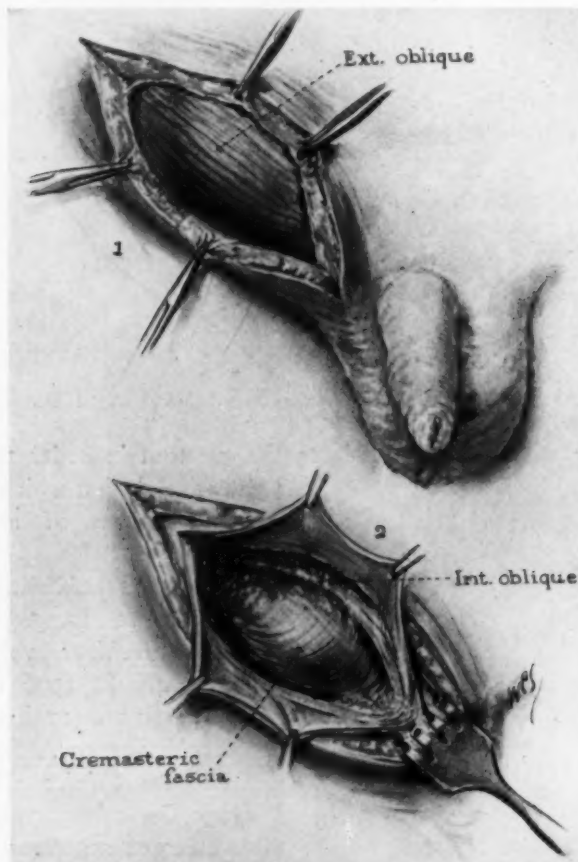


FIG. 6.—(1)—The skin and superficial fascia divided. (2)—The external oblique divided.

been required. The condition, of course, may be unilateral or bilateral. The organ may be arrested anywhere in its passage from the abdominal cavity where, early in intra-uterine life, it lies behind the peritoneum and below the kidney; from this point it may be arrested in its original position, or anywhere from this point to the internal abdominal ring, in the canal, or at the external abdominal ring, or in some abdominal position like the groin or the thigh. Usually at the eighth month of intra-uterine life the organs are in their normal position. (See Figs. 1, 2, 3 and 4.)

There has been a legend passed down from one author to the other that if the organs are not in their normal position at birth that they may come down anywhere between birth and the age of puberty, and that legend, which,

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I believe now to be entirely erroneous, has led to our adopting a wrong point of view in regard to the age at which these cases should be operated upon. I fell into this error and stated on a number of occasions that inasmuch as the organs may descend in the period from birth to puberty that it was wise to defer operation until shortly before the age of puberty. I desire to state quite positively now that I think this position is erroneous, that there is little likelihood, if the organs are not in their normal position at birth, of their descending in the period from birth to puberty, and that I have never seen, in a large experience, a definite example of this kind. There is, however, a not infrequent condition which makes it appear as though such a descent did take place and this condition I have studied very carefully and desire to report upon.

These are cases where there is a very rudimentary empty scrotum containing no testicles, but on careful examination one can feel the small testicles just beneath the skin above the scrotum, and with gentle pressure the testicles in these cases can be pushed down into the scrotum by running the fingers from above downward in the groin, and brought down so that they can be seen and felt definitely in the scrotum. When the fingers are withdrawn, the testicles slip up out of the little empty scrotum and apparently you have the condition of undescended testicle, when as a matter of fact that condition does not exist at all, because as these children grow up these testicles develop normally in the enlarging scrotal pouch and give the parents and the physician the impression that they are cases of undescended testicles which have come down in the period of puberty.

I have been repeatedly called upon to operate on these cases. I was at one time called to a distant city to operate on one of these cases by a very good surgeon who had invited some twenty or thirty surgeons to see the operation on the case. The little patient was sent to the operating room. I made a careful examination. There was nothing in the scrotum, but, without any difficulty, by gentle pressure of the fingers the testicles could be easily brought down in the scrotum, and I assured my surgical colleague and the parents that from my experience I was quite confident that the child would develop normally.

Year after year we have been operating upon these cases earlier and earlier, and I am coming to the position that any time after the first year or two after birth, whenever this deformity is discovered and is definitely demonstrated to exist, and the child is in good general condition, an operation should be performed; and it can be done at that early age to better advantage than at a later period. It is true that the structures are very small and the tissues very delicate and that in operating upon these young children it is necessary to use especially small, delicate artery and tissue forceps and instruments, also very fine catgut; everything in keeping with the very small and very delicate structure. There are, however, definite advantages in doing the operation at this early age:

First: The structures are more pliable and yielding.

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Second: The cord is more easily lengthened so that the organ can be brought down without tension.

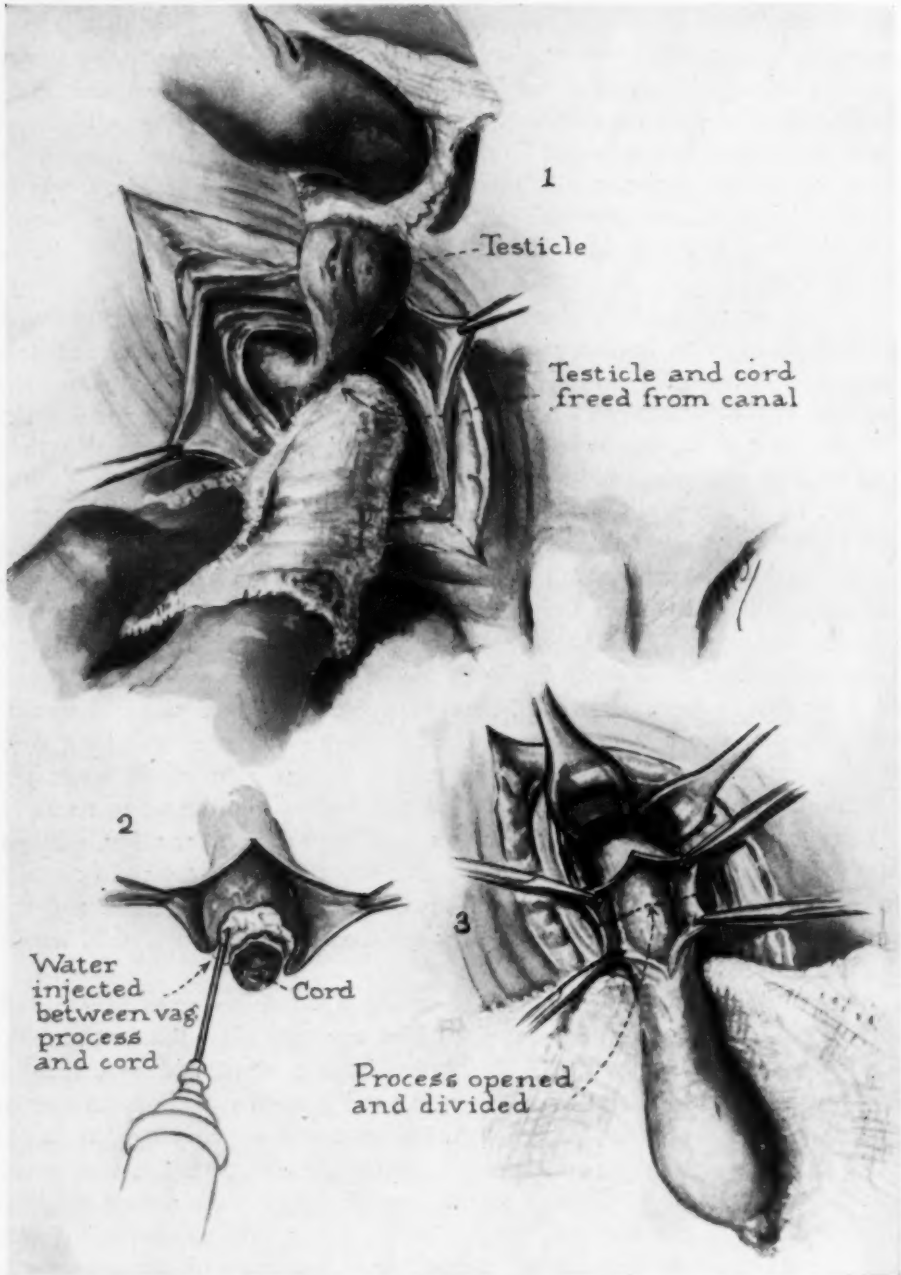


FIG. 7.—Freeing the testis.

Third: There is less danger of doing enough injury to cut off the blood supply.

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Fourth: I believe there is a better chance for normal development.

The results which we have obtained in these very early cases have been most satisfactory. During the last few years some interesting physiological

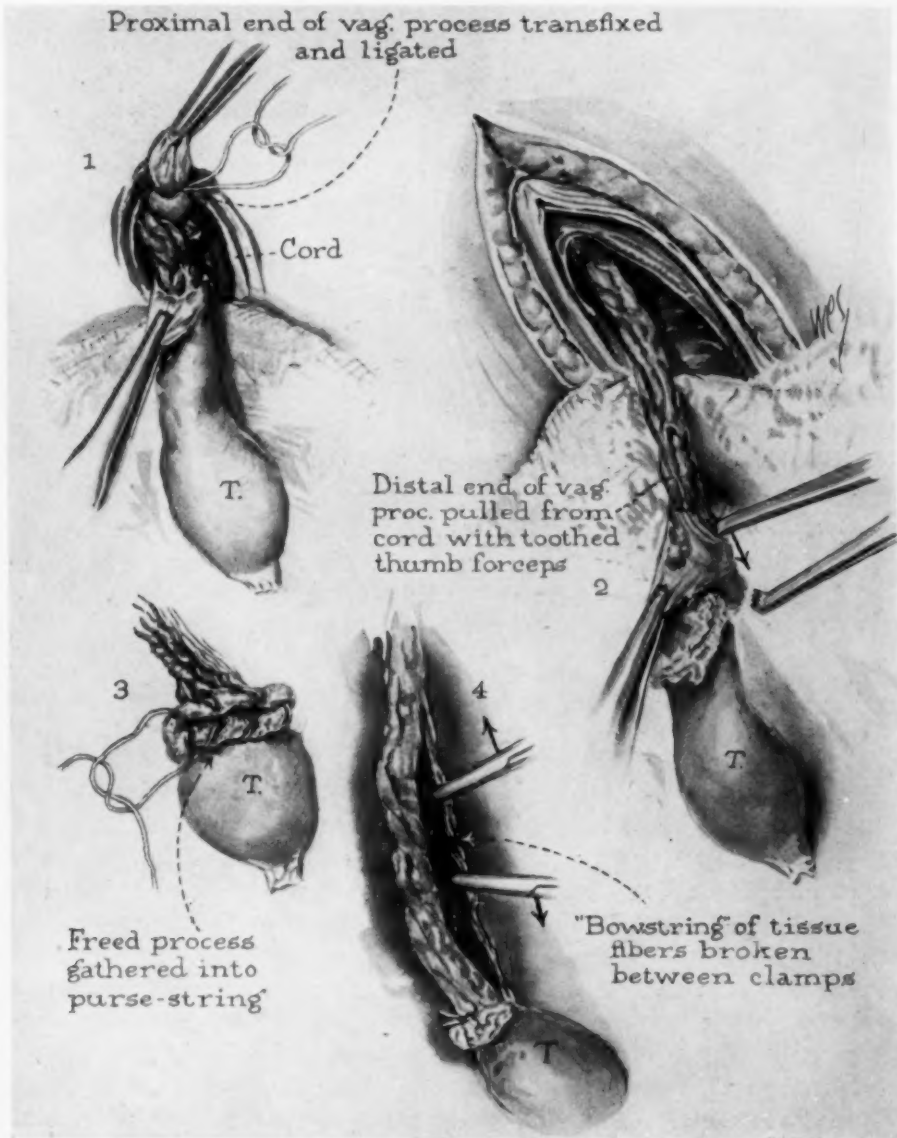


FIG. 8.

work has been done by Dr. Carl Moore,¹ of the University of Chicago, on this subject of undescended testicle and the results of his work argue very strongly for early operation in this condition.

I cannot present these articles in full but I desire to give you the essen-

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tial facts. Doctor Moore found in his experiments that if he took healthy young animals and placed the testicles into the peritoneal cavity that they

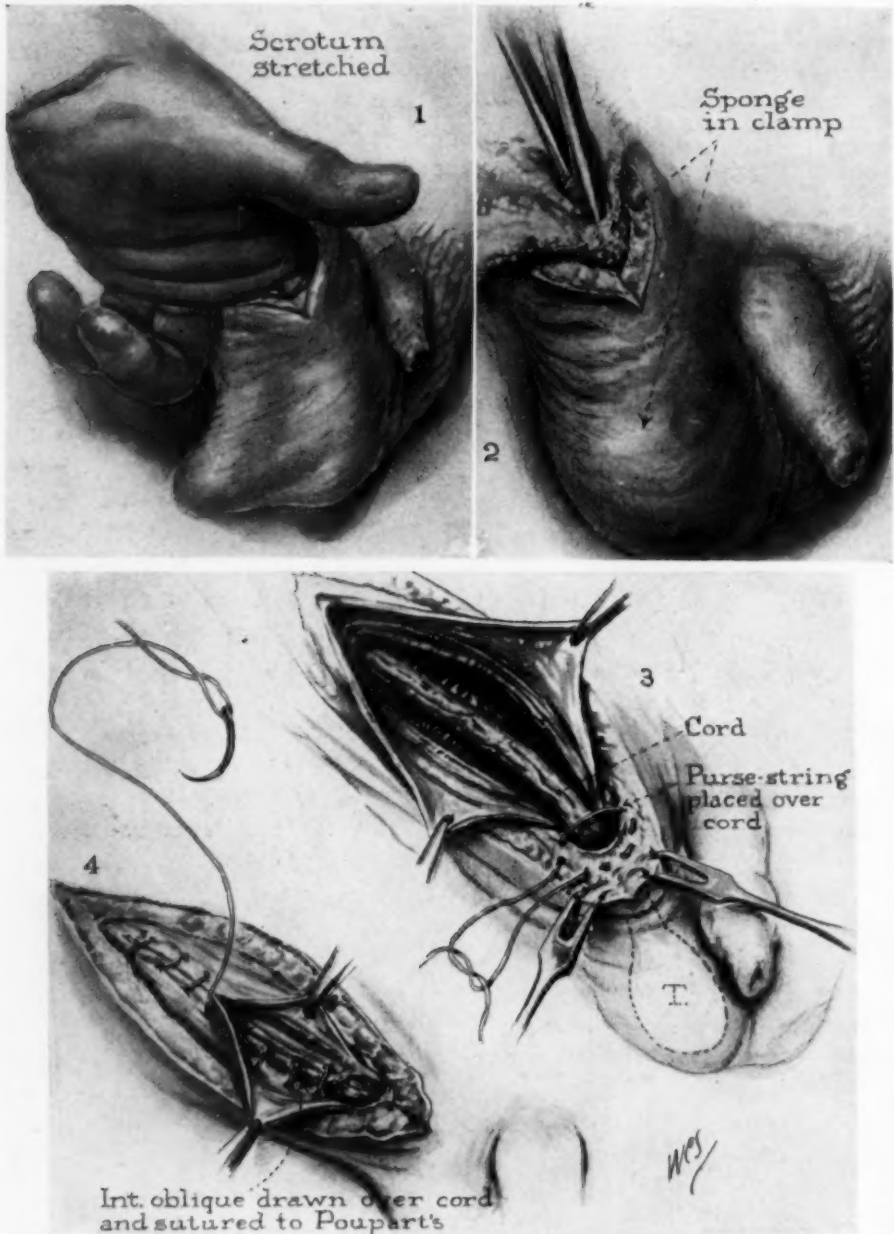


FIG. 9.

gradually degenerated and they did not develop to full function. He found also that if after placing the testicles in the abdominal cavity for a short time, he then brought them back into their normal position, that the degenera-

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tive processes that had occurred in that short period were recovered from and that the organs went on to full development and functioning after being replaced in their normal position. He carried out some interesting experiments, demonstrating, as he thinks, that in higher vertebrates where the male gonads are in the scrotum and not in the abdominal cavity that the slight difference of temperature between their being in the abdominal cavity and in the scrotum makes the difference between a degenerated organ and one with full development and function.

If Dr. Carl Moore's conclusions are correct they form a strong argument for early operation for undescended testicle.

There are logical reasons why practically all of these cases of undescended testicle should be operated upon and operated upon early.

First: Their failure of development in a normal way in this abnormal position, as demonstrated experimentally by Carl Moore and as confirmed by clinical experience.

Second: The fact that they are all associated either with an actual hernia or a potential hernia which can be corrected at the time of the operation.

Third: The importance both from a physiological standpoint and a psychological standpoint of relieving this deformity.

Fourth: The greater danger from trauma in their abnormal position and, finally, possibly a greater risk of malignant degenerative processes.

In our large series of cases we have had no mortality from operation. With sufficient training and experience the operation can be done with little more difficulty than the ordinary operation for radical cure of hernia. Practically all of the children under the age of puberty who are brought to the surgeon should be operated upon, the large majority of those from puberty up to twenty years should also be operated upon; there are a limited number of cases of more advanced age, especially the cases which are unilateral, with one normal testicle and the retained testicle entirely within the abdomen so that it is not palpable and has never given rise to any trouble, where good judgment would veto operative procedures in these individual cases.

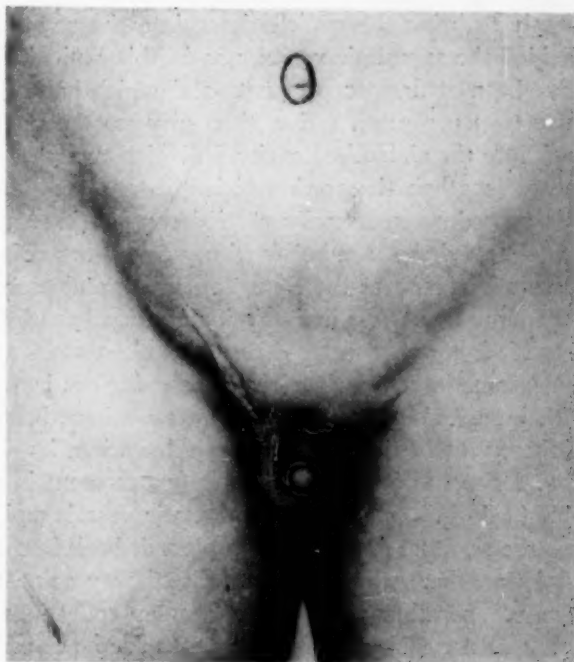


FIG. 10.—The result of the operation.

It is difficult to describe the details of the operation in words alone and on that account I have made a series of sketches which show the different stages of the operation which I shall present to you.

Before doing this, however, I want to say that I have been a good deal surprised and a good deal shocked at the evidence of the careless way in which many medical men read descriptions of operative procedures, and then without a complete understanding or without any mastery of the subject proceed to operate in a bungling way. I would cite as evidence of this fact two examples. In developing the operative technic I found that in a small number of cases, 5 or 10 per cent., I was not able to lengthen the cord sufficiently to bring the testicle down into the scrotum without tension unless I divided the spermatic vessels; so in this limited number of cases which may have been at first 10 per cent., and which has since dropped down to 5 and later to 3 per cent., rather than give up the operation and push the organ back into the abdominal cavity I divided the spermatic vessels, which enabled me to lengthen the cord sufficiently to place the testicle into the scrotum; this procedure necessarily carried some risk. Much to my horror and chagrin I found that a number of my colleagues referred to the division of the spermatic vessels as the Bevan operation and proceeded to do the division of the spermatic vessels indiscriminately in all cases, with resulting atrophy and necrosis in a considerable percentage. As a matter of fact we have not ligated the spermatic vessels in a single case for the last four or five years, because with increased study and experience we have been able, without the division of these vessels, to bring the organ down into its normal position without tension. I should not, however, hesitate a moment in a case where it was impossible to do this to ligate the spermatic vessels and to bring the testicle down into the scrotum rather than to place it back into the abdominal cavity.

As another example of the casual way some medical men read descriptions of operations, one of my German colleagues in referring to the purse-string suture which I place at the neck of the scrotum in front of the cord leaving ample room for the cord behind, after reading my article stated that he thought it was bad surgery to put a purse-string suture at the neck of the scrotum surrounding the cord because it was sure to interfere with the circulation of the testicle.

The various steps of the operation are very simple and very easily understood. Undoubtedly one can acquire by experience in a number of cases a manual dexterity in handling these delicate tissues that will enable the operator to improve his technic and his results.

The patient is anesthetized, usually with ethylene. I shall attempt to describe to you the details of the operation.

The incision made is exactly the same as that which we employ in operations for the radical cure of hernia. I am careful not to extend the incision into the scrotum, but keep it just above the scrotal tissue. (Fig. 5.) I divide the skin and superficial fascia, and in the superficial fascia I divide the small arteries and veins, branches of the femoral artery and vein, that pass up above Poupart's ligament, at the lower angle

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of the incision the superficial external pubic, and about the middle of the incision the superficial epigastric.

After dividing the skin and superficial fascia and clamping these small vessels, I expose fully the white shining aponeurosis of the external oblique, and as I approach the external ring I come to the testicle, which is surrounded by a large peritoneal sac and covered by the three layers of fascia found in inguinal hernia. (Fig. 6-1.) I very carefully separate this peritoneal sac from the surrounding fascial layers. I now split the external oblique over the canal for a distance of about two inches well up to the internal ring. (Fig. 6-2.) I am now able to bring the testicle out of the incision and place it upon an abdominal pad. Making a little tension on the testicle and the peritoneal sac surrounding it, I bring that part of the peritoneal process surrounding the cord well into view and free the cord well up to the internal ring. (Fig. 7-1.)

The next step of the operation is to divide the peritoneal process transversely at a point about an inch below the internal ring. This requires a delicate dissection, and we have developed some operative technic that is of value. I first split the vaginal process by a short incision, about one-half inch in length, parallel with the cord, I then place on the edges of the incision in this thin peritoneal process four small artery forceps, mosquito forceps, so as to be able to make the peritoneum tense. (Fig. 7-3.) It is difficult to dissect off the peritoneal vaginal process from the cord. In order to facilitate this dissection I take a fine hypodermic needle and syringe and inject some normal salt solution under the peritoneum, so as to lift the vaginal process up from the cord. (Fig. 7-2.) This makes the separation of the peritoneal process much easier. The peritoneum is so delicate in the child, being like tissue paper, that you must make a very delicate and careful dissection. I have now completed the transverse division of the peritoneal process, and have stripped the upper part of the vaginal process well up to the internal ring. I now ligate this upper end that enters into the general peritoneal cavity with catgut ligatures, just as we do the stump of a hernial sac. (Fig. 8-1.) Picking up the lower portion of the vaginal process with fine dissecting forceps with teeth, I strip it down from the cord so as to expose the entire length of the cord uncovered by any peritoneum. (Fig. 8-2.) The lower part of the peritoneal pouch is used to make a tunica vaginalis for the testicle. This is accomplished, either with a purse-string suture or simply a running catgut suture closing the opening. (Fig. 8-3.) As I lift up the testicle and the cord there is still some tension, but I find as I examine it carefully that this tension, preventing a sufficient elongation of the cord, is due to some shortened fibrous bands, which I tear across between dissecting forceps. These bands are derived from the fascial coverings of the cord and the vaginal process. I regard this as an important step in the operation, and it is one that should be thoroughly understood. (Fig. 8-4.) One can with care divide and tear these shortened fibrous bands, leaving simply the vas and its vessels and the spermatic vessels, without interfering in any way with the essential structures in the cord. You will see that by this manipulation you have been enabled to free the cord, as a rule, for four or five inches, a length quite sufficient to place the testicle in the scrotum without any tension whatever. With the index and middle fingers and a blunt dissection, and by packing into it enough gauze, I now make a large pouch in the scrotum which must be large enough to receive the testicle without compromising it in any way. (Figs. 9-1 and 9-2.) The scrotal tissues are so elastic and so yielding, that with the gloved fingers and gauze packing we have always been able to make a scrotum large enough to receive the testicle without pressure. The organ is now placed in this pouch, and with a purse-string suture of catgut the neck of the scrotum is closed, this suture being one that simply goes through the superficial fascia and does not involve the skin or include the cord. This suture must not endanger the blood supply of the testicle. (Fig. 9-3.) This prevents the testicle slipping up into the groin, and keeps it well down in the scrotum. The canal is now closed, not as in a Bassini operation, but with the cord deeply situated in the canal; the transversalis and internal oblique are sewed to the shelf of Poupart's ligament over the cord, and the

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external oblique is then closed. (Fig. 9-4.) The skin and superficial fascia are closed in the same way that we would close them in a hernial operation. You will find that the organ is now in the scrotum without any tension whatever, looking very much the same as on the other side. (Fig. 10.)

I would like to emphasize the fact, that the technic must necessarily be difficult to one who undertakes it for the first time, especially without having had the opportunity of seeing a number of these operations done by one who has had experience with it. I would also like to emphasize the fact, from my observation of the cases that have been done by some inexperienced surgeons, that the operation has not infrequently been undertaken by men who have not fully understood the technic of the procedure, and who have not carried it out in all its details. I would like also to emphasize very strongly the fact, that division of the spermatic vessels is but exceptionally called for, and is not at all an essential part of the operation which I have developed; that it is in our own hands not necessary in 5 per cent. of the cases. On the other hand, wherever it is indicated it should be done and done thoroughly, on the principle that the basic idea of my operation is the necessity of placing the testicle in the scrotum without any tension whatever. Care should be taken in the primary dressing of the case not to put on enough pressure over the groin to interfere with the circulation in the cord.

On the whole, the operation seems to me to be one of the most interesting pieces of surgical anatomy in the whole field of operative surgery. The skilful unraveling of this congenital condition, which enables the surgeon to accomplish in a half hour by good operative technic what requires weeks and months in the process of development, with, as a rule, perfectly satisfactory results, has furnished one of the most satisfactory examples of modern surgery.

REFERENCE

- ¹ Moore: Gonad Transplantation in the Guinea Pig. *Jour. Exper. Zool.*, vol. xxxiii, 1921; Testicular Reactions in Experimental Cryptorchism. *Am. Jour. Anat.*, vol. xxxiv, 1924; The Activity of Displaced Testes and Its Bearing on the Problem of the Function of the Scrotum. *Am. Jour. of Phys.*, vol. lxxvii, 1926; Scrotal Replacement of Experimental Crytorchid Testis and the Recovery of Spermatogenic Function. *Biologic Bull.*, vol. li, August, 1926.

DISCUSSION: DR. JOHN H. JOPSON, of Philadelphia, expressed the satisfaction with which he had practiced Doctor Bevan's operation for many years. At the Children's Hospital and elsewhere he had had occasion to see a good many of these cases both in the wards and in private practice. A good many years ago he reported a small series before the Philadelphia Academy of Surgery. He received many requests for reprints of that paper, showing what an interest there was in the subject at the time.

A much more extensive experience with the operation and a checkup on the literature from time to time had further confirmed his opinion that this is, as Doctor Bevan has said, practically a standardized operation. If the profession follows the directions which he has laid down and the points which

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he has emphasized today, and especially with reference to the careful division of every tiny band of fascia along the vas and the vessels, very few indeed are the cases in which the testicle cannot be brought down to a satisfactory position in the scrotum. The cases are very few in which either the Ombrédanne operation or the operation of Torek will be needed. He thought that the efficacy of the original Bevan operation, in the hands of one who is accustomed to practice the operations for hernia in children, had been amply demonstrated.

As to the time at which this operation should be performed, his own practice had been to advise that unless there is a troublesome hernia associated with it, it should not be done before the age of six years and always before the age of twelve.

As to the percentage of these cases which have a hernia association: Eccles in his book written many years ago said, "the association of hernia was 60 per cent."; Bull has said, "they always have hernia," which is certainly far from the truth. His own experience corresponds more nearly with that of Eccles.

DR. JOHN B. WALKER, of New York City, said that at the Hospital for the Ruptured and Crippled, during a period of twenty-eight years, there were observed 80,736 cases of inguinal hernia in the male, of which 1357 or 1.68 per cent. were cases associated with an undescended or maldescended testis. Four thousand four hundred fifty-three cases of inguinal hernia were operated, of which 334 or 7.5 per cent. were associated with an undescended testis.

In 50 per cent. of these cases, the ages varied between eight and twelve, but in cases associated with a large hernia, the operation was performed at an earlier age, for it was found inadvisable to use a truss as it caused pain and an irritating pressure upon an already undeveloped organ.

The Bassini operation was employed, but the cord was not transplanted and it was brought out at the lower end of the wound in the largest number of cases. Very rarely was it necessary to divide the vessels, the main objective being to dissect most carefully and to divide the finest fascial fibres; suturing the testis to the bottom of the scrotum is not advised. Practically all cases were accompanied with a hernial sac.

Results.—As regards location of the testis, over 50 per cent. remained in the scrotum or outside the external ring. As regards sarcoma, the undescended testis is more liable to trauma and it also shows a greater tendency than the normally placed testis to undergo malignant degeneration.

DR. ALEXANDER PRIMROSE, of Toronto, Canada, had performed the Bevan operation a good many times with satisfactory results. He asked Doctor Bevan and others who had had an extensive experience with the undescended testis, if they consider the possibility of malignant development in the retained testis an indication for placing it in its normal position. Also if in their experience an undescended testis is frequently associated with other

failures in development. He asked these questions because of the findings in the following case which presented certain features of interest.

A good many years ago he was assisting his senior colleague in Toronto in removing a large malignant mass from the abdominal cavity. The tumour growth had occurred in an undescended testis. After an extensive operation the patient died and at autopsy instead of the diminutive structure, usually called the "uterus masculinus," which exists as an offshoot from the floor of the prostatic urethra, there were a complete uterus, tubes and vagina.

The case was of further interest because it proved conclusively that the so-called "uterus masculinus" represented not only the female uterus but in addition the vagina. This fact was obvious because the cervix of the specimen possessed the well-marked "plicæ palmatæ" which is a characteristic marking on the mucous surface of the normal cervix. Distal to the cervix was the body of the uterus and on its proximal side the vaginal tube which joined the urethra. This case was reported in full in the *British Journal of Anatomy and Physiology*, vol. xxxiii, p. 64, October, 1898. This case has been quoted more than once in the literature because it affords conclusive proof that the so-called "uterus masculinus" represents not only the uterus but also the vagina.

It would be of interest to determine in a large series of cases: (1) The frequency of the development of malignancy in the testis retained within the abdomen, and (2) whether or not other failures in development are frequently associated with undescended testis.

DR. ALEXIS V. MOSCHCOWITZ, of New York City, said that he in 1910 published an article in the *ANNALS OF SURGERY*, entitled "Anatomy and Treatment of Undescended Testis, with Special Reference to the Bevan Operation." This paper had given him more trouble than any other he had ever written. For the conclusions contained therein, he had to apologize before the New York Surgical Society and before the surgical section of the New York Academy of Medicine. The final conclusion of the paper is as follows: "The purpose of this paper is, therefore, an advocacy of the Bevan operation. I do this not only from a sense of pleasure over the results that it has afforded me, but also because the operation, if the infrequency with which the operation has found its way into the literature is a criterion, has thus far found few adherents."

Primarily, he thought that the operation had been greatly misunderstood. This misinformation lies in the fact that the division of the spermatic vessels is looked upon by the majority as the essential part of the Bevan operation. This is not so; on the contrary, today, Doctor Bevan himself advised very strongly against it.

The paper previously alluded to was based upon eighteen patients who were operated upon by the Bevan method. Since that time he had operated a larger number of patients. A few years ago he sent for as many of these patients as he could follow up. The total number was 130 and a fair number returned for examination. To his great surprise and chagrin, in all cases but

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two, when the spermatic artery was divided, there was a complete atrophy of the testis. It is not surprising, therefore, that he had given up entirely this part of the operation.

He believed that the crux of a correct operation for undescended testis lies in a complete mobilization of the testis without the least injury of the spermatic vessels. If it is impossible to obtain this through the ordinary inguinal incision, distal to the internal inguinal ring, extend the incision somewhat upward and separate the internal oblique and inguinal transversalis muscles, as in the McBurney incision. Through this incision the spermatic vessels are mobilized as high up as possible, and in a majority of instances it will be found that the testis can be mobilized sufficiently for transplantation into the scrotum.

DR. WILLIAM E. LOWER, of Cleveland, Ohio, said that the operation which Doctor Bevan had described has been a great advance in the treatment of this class of cases.

He had done this operation as nearly as possible, as he has described it, but occasionally had atrophy of the testicle result. Perhaps he had stripped off the cord too closely. Yet, it seemed to him that there are some of these cases in which it is almost impossible to get the full length of the cord without dividing all the vessels, except those accompanying the vas.

One point is important, namely, that there must be no tension on the testicle. The cord should be long enough to be laid down beside the scrotum without tension. Wherever there is much tension the operation will fall short of the purpose. Methods of holding the testicle down in the scrotum are as a rule failures.

If this operation can be done upon younger children, and Doctor Bevan has demonstrated that it can be, the results will be much better. One can perhaps prevent some of the calamities which have occurred later.

DR. FRANZ TOREK, of New York City, said that he was pleased to hear Doctor Bevan use the expression, "freeing of the vas and vessels," and not "the freeing of the cord," because in proceeding simply to free the cord as a whole one will often fail to get the testicle down far enough. The cord has to be considered as consisting of two separate parts, the vas and the vessels. The vas never gives any trouble; the vessels often do.

The picture that he has shown of the finished case is also an ideal one. The testicle rests in a properly pendulous scrotum which is the ideal position. He had not had the good fortune of seeing Doctor Bevan's personal cases but he had seen a great many others that were operated according to Doctor Bevan's method, and the vast majority of them did not show the result seen in this picture. They have had a testicle somewhere very close to the pubis, a position which is not desirable because the testicle is then exposed to the danger of injury from any blow.

Having seen so many results in which the testicle had slipped up again to the pubis and even higher, he had gone a step further than simply placing it into the scrotum. In an article published November 13, 1909, in the *New*

York Medical Journal, he described the method that he had been using. It consists in freeing the vas and vessels according to the method which has been shown today. After the freeing of the vas and vessels the testicle is brought out through an incision in the scrotum, then carried through an incision in the skin of the thigh to the fascia of the thigh to which it is anchored without any tension whatever, the wounds of the skin of the scrotum and of the skin of the thigh being sewed to each other. In that condition the testicle cannot slip back. It is not under any tension. If tension of the vessels were permitted, the performance of the operation would not be in accordance with his advice.

The result is that after the scrotum and testicle are again released from the thigh the testicle invariably rests at the bottom of a pendulous scrotum.

While the testicle should never be under any tension, the scrotal skin is under a slight degree of tension by being brought down to the thigh. This is not a disadvantage because skin stretches very easily, but on the contrary it is an advantage because it forms a scrotum. In many of these cases there isn't any skin to amount to anything at one's disposal, but by this operation a scrotum is made. It never takes longer than three months to make such a scrotum by attaching the rudimentary scrotum to the thigh. In many cases it could be removed very much earlier.

DR. HENRY H. M. LYLE, of New York City, thought that Doctor Torek had added a physiological refinement to Doctor Bevan's operation which makes for better end-results. It is interesting to note that when this subject was under discussion at the Surgical Section of the New York Academy of Medicine and the end-results of Torek's operations were demonstrated by Dr. Herbert Meyer, it was the unanimous opinion that the results shown by him were remarkable. The testicle was freely movable in a swinging pear-shaped scrotum, which to all appearances was fully developed. He felt sure that his own end-results had been materially improved since he adopted Doctor Torek's operation as his standard. He had seen no atrophy, the testicles had increased in size and are freely movable at the bottom of a well-developed scrotum. Quite lately he had a testicle that was so large that there was insufficient room in the poorly-developed scrotum to hold it. Now the testicle is in a normal mobile pear-shaped scrotum. It is too early yet and it is a difficult matter to get figures on the functional end results, but if increase in size and development go hand in hand, then the Torek operation should yield good functional results.

DR. CHARLES A. PORTER, of Boston, Mass., remarked that the interesting question in connection with these cases is not so much where the organ is, but whether it is worth anything where it is.

He would like to hear some reports on the ultimate results, what percentage of cases of undescended testicle has been subjected to either one of these operations and has continued to develop and become a useful pubic organ? He happened to know from experience that one cannot strip the cord in a young child and expect more than about 50 per cent. of them

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to continue to develop in comparison with the opposite testicle that happens to be down. It will arrest the development. Have these individuals who, prior to the operation, one had reason to believe would be sterile, been rendered not only free from their deformity but made fruitful members of society?

DR. ARTHUR D. BEVAN (in closing the discussion) said that, in the first place, undoubtedly it is difficult, unless one has seen the operation done by one with a good deal of experience, to do the operation from simply a written description of it. He had attempted in his paper to present those points that he thought might help out.

There are two points which he wanted to bring out particularly. The first is the importance of operating upon these cases early. Since surgeons have been operating upon younger children the operation has become easier and the results have become better. Some men advocate operating on these children as early as the first year, right after the child has been weaned. He had not gone that far, but one can say that if the operation is done within the first three or four years the results will be very much better than they have been in the past.

He emphasized the importance of the work of Carl R. Moore, referring to his pamphlet entitled, "Scrotal Replacement of Experimental Testis and the Recovery of Spermatogenic Function in the Guinea Pig." It is a reprint from the *Biological Bulletin* of August, 1926. The reprint also contains some references, not complete but interesting and valuable, to the speaker's work, the work of Joseph Griffis that was done as early as 1893, the work done by Lipschutz and seven or eight papers which have been done by Moore.

Moore's contribution shows beyond any question this fact: If the testis is left in the abdominal cavity or in the canal it never does develop. Certainly in lower animals where one can control the situation Moore has shown that it does develop and function if placed in the normal position.

TOTAL CYSTECTOMY AND PARTIAL PROSTATECTOMY FOR INFILTRATING CARCINOMA OF THE NECK OF THE BLADDER

REPORT OF EIGHT OPERATED CASES

By EDWIN BEER, M.D.

OF NEW YORK, N. Y.

ALMOST all the tumors of the bladder that we are called upon to treat arise from the epithelial layer. Most of these tumors some twenty years ago failed to respond to surgical treatment, but during the last two decades certain groups of these epithelial tumors have been proven to be amenable to surgical curative methods.

A fair proportion of these epithelial growths are surface tumors and do not, when first seen, infiltrate the bladder wall even though they may recur subsequently—perhaps years later—as either surface tumors or as infiltrating neoplasms. Whenever the tumors are definitely surface tumors with no tendency to infiltration, they can readily be destroyed through the cystoscope with the high frequency current or by proper surgical technic through a suprapubic incision, measures being taken to prevent implantation of live tumor cells on the raw surfaces as well as measures to protect the parietal wound.

In those tumors that infiltrate the bladder wall, the therapeutic measures are much less successful, and depending upon the degree and extent of infiltration, the results of therapy vary. It can be said that tumors situated in the posterior, lateral or anterior walls, even if they infiltrate, can be successfully resected, and this applies to papillary carcinomata as well as solid infiltrating carcinomata.

In the tumors of this group which involve a single ureter and reach close to the neck of the bladder at one point, successful resections with the electric knife, or the electric cautery with re-implantation of the ureter in a new place, or ligation of the ureter, are perfectly feasible and frequently give satisfactory results even though one must admit that it is often difficult by palpation to determine accurately the limits of the infiltration and thus make the incision well outside of the tumor area. Primary coagulation of the tumor surface, before the excision with the electric knife, is, undoubtedly, the best way to prevent breaking off of implants. Another aid in controlling implants is filling the wound with alcohol for five minutes before suturing the resected bladder.

Unfortunately, however, in addition to the groups included in the above descriptions, there is a group of cases in which the trigone is so extensively involved that the ureters cannot be spared and both ureters have to be sacrificed. In addition, many of these cases have extensive involvement of the

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neck so that the infiltrating growth involves half or more of the sphincter area and has invaded underlying tissues, particularly the adjacent prostatic tissues in the male. In this group of extensive infiltrating growths situated close to or in the neck of the bladder involving frequently the ureter orifices, the problem is most serious. What should we do? What can we offer these patients?

This paper is prepared as a contribution to this subject and deals with one form of treatment for this group of desperate cases.

Up to date, four methods of treatment have been applied to the cases falling in this group:

1. Suprapubic cystostomy to relieve the local irritation, bleeding, tenesmus, etc.
2. Suprapubic cystotomy with more or less deep electrocoagulation.
3. Suprapubic cystotomy with introduction of radium seeds deep into the infiltrating growth.
4. Total cystectomy and partial prostatectomy.

Treatment No. 1 is evidently purely palliative and often fails to give real relief—pain, bleeding and tenesmus continuing almost unchanged.

Treatment No. 2—electrocoagulation—is usually little more than palliative, as electrocoagulation frequently will not extend to any great depth, and if the tumor is deeply infiltrating, the electrocoagulating current will fail to reach the deeper layers.

The third method—introduction of radium seeds—has, undoubtedly, every once in a while destroyed deeply infiltrating growths in and about the neck involving the trigone, but even with the radium seeds the results are most irregular, inconstant, and only a few cases have been definitely cured by this procedure in a series of almost three dozen treated in this way. Patients treated with radium are, as a result of the radium irritation, liable to be rendered most uncomfortable for months, and if the radium is placed in the bladder wall near the ureter orifice, cicatricial stenosis with subsequent hydro-ureteronephrosis, which readily becomes infected, frequently develops.

The three methods just mentioned of dealing with this group of unfavorable cases have to compete with the fourth method which really offers something to these unfortunate cases, and during recent years a number of surgeons have been studying the problem presented by such cases and have been recommending more radical surgical procedures. Whether, in the long run, total cystectomy is going to prove to be the method of choice, it is impossible to say at this moment, but those of us who have given total cystectomy in this group of cases a trial, must feel a certain compulsion to put our cases on record so that ultimately we can determine what patients have gained by this method of approaching the problem as compared with the three other methods mentioned above.

The textbooks on surgery and some of the recent papers have placed such a high mortality on total cystectomy that the average surgeon dreads to undertake such an extensive and more or less mutilating procedure.

According to Zuckerkandl,¹ the mortality of total cystectomy, as shown by sixty-four cases collected from the literature, was 50 per cent. This high mortality was attributed to the fact that the operation was done in one step. Scheele,² in a more recent review in 1923, came to somewhat similar conclusions and stated that the operation should be done in two steps regularly, as it diminishes the mortality. In the first step, the ureters were to be disposed of—preferably by implantation into the sigmoid; and in the second step, the bladder was to be removed well outside of the involved area with the adjacent fat, etc. In forty-three cases collected by Scheele—in which the operation was done in one step—there was a mortality from operation of 53.5 per cent., whereas in seventeen cases operated in two steps, three died following the first operation, and of the fourteen that remained, two died following the second operation. Thus, in seventeen cases in which the two-step operation was done, there were five deaths, or a little less than 30 per cent. mortality. Janssen³ quotes very similar figures based on the publications of Wildbolz, Watson, Verhoogen, Reischmer and Petrow, the mortality varying in this operation from 50 to 60 per cent. He concludes with Wildbolz, in view of the high mortality, that total extirpation of the bladder in extensive new growths is not to be recommended. H. H. Young⁴ writes in the same strain, "the high mortality and the rarity of success render this operation thoroughly unjustifiable."

More recently, Federoff⁵ has published a series of seven cases of total cystectomy and has also recommended a two-stage procedure, the ureters being introduced into the sigmoid at the first operation. Some of the patients on whom he had been able to carry out the two-stage operation were alive five and six years following the total cystectomy. Unfortunately, at least three cases, out of the twelve cases underlying his report, died following the ureter anastomosis before the cystectomy could be carried out. In one case he did a bilateral nephrostomy, and in another he transplanted the ureters into the anterior abdominal wall without touching the bladder. In a later report published in Russian,⁶ Federoff is said to have carried out total cystectomy in ten cases, and according to this report, he still favors the above method of procedure in two steps. More recently, Coffey also has declared for primary transplantation of the ureters into the large intestine according to his technic with a secondary total cystectomy. In his recent paper⁷ he reports one such operated case.

Another point must be considered in connection with this whole problem and that refers to the advisability of attempting a total cystectomy in the presence of definite metastases. Carcinoma of the bladder most frequently remains localized and distant metastases are not common. In fact, in sixty-one cases of total cystectomy collected by Scheele, only five had metastases. Unless the metastases are so placed as to make the condition absolutely hopeless—*e.g.*, in the lungs, liver or spine—it is questionable whether patients should be refused the relief from torture afforded by total cystectomy. In one of my cases (Case II) the local metastasis in the pelvis remained quiescent

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for five years, and in another (Case VIII) radium seeds were placed in an iliac gland deposit that could not be removed. Local metastasis surely should not contraindicate total cystectomy and perhaps even distant deposits should frequently be ignored, in view of their usually slow progression and the great relief given to the patient from his local condition by total cystectomy.

From the above brief summary several conclusions might be drawn. First, that the mortality of total cystectomy at present is high unless operation is done in two steps; second, that there is a definite mortality following the transplantation of the ureter into the bowel as the first step in the operation; and third, that a number of patients in whom total cystectomy has been done have been relieved of their local condition and remained well for many years following the operation. The exact duration of life following this operation in sixty-two cases collected from the literature by Scheele has been carefully tabulated in his paper.⁸ Unfortunately, many surgeons have published their cases shortly after the operation and the end results are not known. From Scheele's tabulation, I gather that in the sixty-two cases reported, sixteen patients lived over one year, and seven patients lived over three years—the longest period being fifteen years.*

The disposition of the ureters in these cases has up to date presented one of the main problems. No matter where the ureters are transplanted, attacks of pyelonephritis and secondary hydronephroses with infection are liable to develop. The greatest ingenuity has been employed to meet this problem. The ureters have been transplanted into the sigmoid intraperitoneally; into the rectum on its extraperitoneal surface; into loops of the intestine separated from the intestinal tract; into an excluded loop of the sigmoid, an artificial anus having been made in the upper sigmoid. They have also been left in the wound or transplanted into the urethra, or into a more or less closed-off vagina. In some cases the ureters have been brought out to the skin near the incision or near the anterior superior iliac spine; and in others again, the urine has been deflected by a nephrostomy or lumbar ureterostomy.

In an extensive review of this whole subject published by M. Papin,⁹ he has analyzed a large series of cases (181 total cystectomies) in which the urine was deflected from the bladder, and he has found that the mortality of implantation in the intestine, according to published reports, is 59.2 per cent.; implantation into the vagina 50 per cent.; implantation into the urethra 100 per cent.; whereas, implantation of the ureters into the iliac fossæ or lumbar regions, or into the wound as well as deflection of the urine by nephrostomy, is accompanied by a mortality of 28.7 per cent. Despite this careful summary, it is very likely that future statistics—where the Coffey technic of ureter implantation into the bowel is more carefully carried out—will show a great improvement. In Papin's statistics, he studied eighty-one cases of ureter implantation into the bowel, in which forty-eight patients died. Judging from this report and my own experience to date, transplantation of the

* A patient of Pawlik whose ureters were transplanted into the vagina which had been converted into a reservoir by a plastic operation.

ureters into the skin of the iliac regions seems to be, at the present moment, the most satisfactory method of disposing of the urine.

In addition to the mortality, a serious objection to transplantation of the ureters into the intestine as the first step, is to be found in the fact that every total cystectomy starts as an exploratory operation; and if one has transplanted the ureters into the intestine as the first step, one has committed one's self to a total cystectomy which at the second operation may be found to be unnecessary. Federoff encountered this serious mischance in a physician on whom he operated.[†] The cystoscopic picture, the palpatory findings and the cystographic studies preoperatively usually make clear to the surgeon the necessity of doing a total cystectomy, but the final decision is rarely reached until the abdomen is opened and the bladder palpated from within the abdomen or inspected and palpated through a cystotomy incision.

Another objection to a preliminary implantation of the ureters into the bowel is to be found in the frequency with which infection develops in these ureters as usually one or both are dilated, atonic and very difficult to anastomose and, therefore, prone to an ascending infection. A large number of cases—many more than have been published—in which the ureters have been transplanted into the bowel with the idea of doing a secondary total cystectomy, have succumbed from this operation; in fact, in the series just quoted from Federoff's clinic, three cases out of the twelve mentioned in his paper, died as the result of ureter implantation before the total cystectomy could be undertaken.[‡] This mortality, it seems to me, is much too high if total cystectomy is to be proposed to patients suffering from infiltrating growths at the neck of the bladder.

In the eight cases described in this paper, there was one operative death; and in this patient the ureters were obliquely implanted into the sigmoid, one kidney was atrophic, and the kidney on which the patient was living became infected through its dilated ureter and the patient died with an acute pyelonephritis. In the remaining seven cases, the total cystectomy was followed by immediate implantation of the ureters in the skin, in the iliac fossæ where the ureters were intubated with catheters or tubes, depending upon the size of the ureters. Both the first case with implantation of the ureters into the bowel and the seven cases of implantation of the ureters in the skin, were done in one step, and only one patient (the first case) in this series of eight, died as the result of the operation.

The operation of total cystectomy is not particularly difficult. It can readily be done through a simple mid-line suprapubic incision, preferably extraperitoneally though there is no objection to opening the peritoneum to determine whether the peritoneum overlying the posterior wall of the bladder is involved or not and whether any visceral metastases are present. If it is involved, it should be left attached to the bladder wall, and the peritoneum

[†] At the second step, he opened the bladder and found it normal, the suspected carcinomatous ulcer (due to radium) having healed.

[‡] v. Scheele, three deaths in seventeen cases following first step.

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on either side united so as to close off the abdominal cavity. Extra cross-cuts into the rectus muscles are absolutely superfluous, and any increase in the incision by resection of the symphysis is to be condemned. On opening the abdomen (in the Trendelenburg position), one should carefully palpate the bladder to confirm the previous diagnosis as one usually can recognize the infiltration corresponding to the neoplasm. If one is in doubt concerning the palpatory findings, the bladder ought to be opened and inspected and palpated from within. At times it may be necessary to remove specimens for immediate microscopic examination § before condemning the patient to a total cystectomy. The bladder can be readily mobilized, dissecting the peritoneum laterally and tying the various vesical arteries and veins. As the bladder is delivered extraperitoneally over the symphysis, the seminal vesicles and ureters are brought into view. The vasa on either side are doubly tied as they cross the ureters, and cut between, and the ureters are temporarily ligated as close to the bladder as is feasible, and cut across below the temporary ligatures which are applied to prevent spilling of possibly infected urine into the wound. The cut-off ureters are allowed to stay *in situ* until the prostate is well delivered, and to control bleeding from the plexuses of the prostate, heavy gut or silk sutures are introduced on either side, having made a pedicle of the prostate very similar to the cervix in supravaginal hysterectomies. The section is then made proximal to the prostatic transfixion sutures with the electric cautery, and the bladder with the upper end of the prostate and seminal vesicles attached is removed in one piece, care being taken not to spill any of the cancerous tissue in the wound. If there is any doubt as to the extent of the prostatic involvement and one wishes to remove the prostate down to the membranous urethra, it may be necessary to make a secondary perineal incision and cut across the membranous urethra before delivering the bladder and prostate. In some cases where there was doubt as to the prostatic infiltration, numerous radium seeds have been introduced into the cut surfaces of the prostate. In one case where a large metastatic gland was surrounding the iliac vessels at the bifurcation of the internal and external iliac arteries which could not be dissected free, radium seeds were introduced into this gland as well. After removing the bladder and as much of the prostate as seems indicated, the ligatures on the ureter ends are grasped, and the ureters are dissected free retroperitoneally so that they can be readily implanted through a gridiron incision near the anterior-superior spine without any tension. In doing this, the peritoneal fold must be pushed upward to avoid carrying the ureter intraperitoneally to the parietes. The ureters usually have to be freed three to four inches when they can be readily brought out beyond the level of the skin and attached with two silk stitches to the skin; then the temporary catgut ligatures are removed, the ureters are intubated with the proper sized catheters or tubes, and a silk thread is tied about the end of the ureter and its contained tube, about one-half to three-quarter inch of the ureter projecting beyond the skin. A small wick of iodoform

§ Pre-operative cystoscopic specimens usually make this superfluous.

gauze is placed on either side of the ureter and the two tiny skin incisions are partly closed and covered with vaseline dressings. To destroy any implants that may have been spilt, the median wound and its large recesses are carefully bathed in alcohol, the patient being lowered to the horizontal position. After five minutes' exposure to the destructive action of the alcohol, the abdominal median working incision is closed in layers with adequate drainage down to the prostate.

This is the technic that I have used in the last seven cases without any mortality. The main objection that I see is to be found in the fact that the patients have to wear a urinal to collect the urine from the two kidneys as both ureters have to be permanently intubated. It would be a great advance if after the patients had completely recovered and one were convinced that the carcinoma had been completely eradicated, one could secondarily transplant the ureters from the skin into the bowel. Up to date, this highly desirable solution of the problem presented by these cases has not been tried by me, and I doubt whether a satisfactory anastomosis of this sort is feasible as these ureters regularly—if not dilated at the time of the first operation—become dilated as the result of their primary disposition in the skin. Pyelonephritis with destruction of the kidney parenchyma has been a very infrequent accident in ureters treated by implantation in the skin. It has occurred, however, when the ureters have not been adequately separated retroperitoneally, which frequently causes some kinking of the ureters and makes for difficulties in passing catheters or tubes from the skin up to the kidney pelves. At times this difficulty can be overcome by using filiform bougies attached to Phillip's catheters, and after the removal of the Phillip's catheters, one rarely has any trouble in introducing fair-sized rubber drainage tubes. In only one of the seven cases did such difficulties arise while the patient was recovering from the total cystectomy, and in one other case—two years or so after discharge from the hospital—there was some difficulty owing to traumatism to the ureter and peri-ureteritis in introducing a tube up one of the ureters. In this latter patient a nephrostomy had to be done to save the kidney which was apparently obstructed by peri-ureteral exudate. In the other five cases there were no serious kidney infections, although in all cases, owing to the tube's presence in the ureter and pelvis, a certain amount of purulent discharge was present in the drainage from the kidneys. To reduce this to a minimum, the patient's kidneys and ureters are washed out once or twice a week with a mild antiseptic solution—such as acriflavine 1:4000—and the urine is kept as sterile as possible with urotropin and acid sodium phosphate. Dietary measures and various acidifiers may have to be used as otherwise the tubes may become incrustated with phosphates; and in one case where this happened, a small presumably phosphatic calculus developed in the renal pelvis. In my cases, as well as in the experience of Papin, the function of these kidneys remains satisfactory, and repeated tests with indigocarmine, and phthalein, as well as studies of the blood chemistry, fail to show any marked functional depreciation.

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In the eight cases reported in the appendix to this paper, there was one death—a mortality of 12.5 per cent. In the last seven cases in which the operation was done by the extraperitoneal procedure with ureter implantation into the skin, there were no deaths. The patient that died, died in the hospital ten days following the operation with infection of his left kidney due to implantation of the ureters into the sigmoid. Of the seven cases that survived, one lived five years (Case II); one lived for nine months (Case III); Case IV with the leiomyosarcoma lived over two months. Cases V, VI, VII and VIII are alive. Case V is alive four years; Case VI is alive one and one-half years; Case VII is alive seven months; Case VIII is alive six months. The full details of these cases will be reported at the end of this paper.

All my patients have been males, and the technic which I have described is applicable to this sex. Federoff has attempted total cystectomy in females and has modified the technic of total removal of the bladder by beginning with an extirpation of the female urethra, which is tied off after it has been dissected free up to the neck of the bladder. This allows him to remove the bladder secondarily from above with a closed-off complete female urethra and prevents spilling of the malignant cells from the neck of the bladder into the peri-urethral tissues. At the same time, it makes for more radical extirpation of these growths as they tend to involve the proximal urethra as well as the neck of the bladder.

From this brief review of my personal experience, it must be evident that the mortality of extraperitoneal removal of the bladder with the adjacent prostate is not prohibitive and that the operation can be done in one step with implantation of the ureters into the skin without undue risk to the kidney's integrity; and, moreover, even though the patients have to wear an apparatus for the collection of their urine, they are relieved of their original painful condition, rendered fairly comfortable, well able to get about, and even to work and earn a livelihood.

CASE I.—Total cystectomy for extensive infiltrating carcinoma of the bladder; intraperitoneal implantation of ureters into sigmoid. Death ten days after operation. Autopsy showed both ureters dilated; left kidney pyonephrosis; right kidney atrophic with dilated pelvis; urinary fistula to sigmoid.

M. B., male, thirty-five years of age. Six months previous to admission patient had painless hematuria and was treated for papillomata of the bladder by a urologist. As the treatment by electrocoagulation had not been satisfactory, patient was admitted to Mount Sinai Hospital in August, 1911.

At cystoscopy, he was found to have four rather solid-looking flat papillary growths in the anterior bladder wall. The adjacent bladder wall was œdematous. The tumors were treated with the monopolar current and rapidly melted away. On reëxamination, the growths had failed to respond satisfactorily, having recurred at once though they were thoroughly and completely cauterized. Specimens removed showed an alveolar arrangement of cells, characteristic of carcinoma.

October 18, 1911, having consented to operation, it was planned to do a resection. On exposing the bladder transperitoneally, it was found to be firm and infiltrated throughout except on the left side of the fundus near the posterior wall. The bladder was opened through this soft and not involved area and palpated, and as the whole organ was dif-

fusely infiltrated, a total cystectomy was decided upon. The opening in the bladder was packed with gauze, and the peritoneal cavity widely exposed in the Trendelenburg position. The peritoneum in Douglas was cut through transversely exposing the vas deferentia, which were tied and cut. Both ureters were exposed. Temporary ligatures thrown around the proximal ends. The left ureter was cut close to the bladder whereas the right, which was involved in disease, was cut one and a half inches from the bladder. The various blood vessels going to the bladder were tied on either side. In this way, the bladder covered with its posterior peritoneal covering was completely freed down to the prostrate where the venous plexuses were ligated. After transfixion, the prostate was cut across with the Paquelin cautery. This allowed of the removal of the bladder, vesicles and upper part of the prostate. Then the ureters were liberated retroperitoneally and brought out through stab wounds in the posterior peritoneum and drawn into the sigmoid through a longitudinal band of the sigmoid. The ureters were pulled through the small openings in this band and attached with chromic-gut traction sutures. Lambert silk sutures were applied externally bringing together the peritoneum over the ureters as in an oblique Witzel operation. Peritoneum from Douglas's pouch was attached over the ureter anastomoses, the ureters being placed one above the other at a distance of two inches. The defect in the pelvis was closed over almost completely by using the lower sigmoid peritoneum. Cigarette drain placed in lower angle of wound and abdominal wall closed in layers.

Following this extensive operation, patient apparently was doing well. On the seventh day there was some urinary leakage through the wound, and sixty to eighty ounces were passing through the rectum. About this time the left kidney region became painful and the patient had a chill and rise in temperature. His condition gradually deteriorated, and ten days after the operation (the left kidney infection being progressive) the patient died.

At autopsy, there was no evidence of carcinoma; the ureters were dilated; the left kidney pyonephrotic; the right kidney atrophic; there was a urinary leakage from the ureter-sigmoid anastomosis.

Comment.||—In this patient, the moderate-sized papillary growths which presented on the mucous membrane of the bladder masked a most extensive infiltrating carcinoma. The response to the high frequency current was unsatisfactory, and the microscopic examination of the tissue led to the absolute diagnosis of carcinoma. At operation, nothing short of a total cystectomy would have been of any avail. The transperitoneal excision of the bladder was performed with a sigmoid implantation of both ureters. The right kidney was atrophic as a result of either the bladder condition or some previous disease, whereas the left kidney, on which the patient was apparently living, became infected; and a moderate leak occurred at the point of anastomosis of this ureter with the sigmoid, and as a result of the severe infection of the left kidney, patient died.

*CASE II.—Extensive infiltrating carcinoma of posterior wall, trigone and neck of bladder. Abdomino-perineal prostatocystectomy through an extraperitoneal approach. Section of the membranous urethra through a perineal incision, and implantation of each ureter in the skin through a gridiron incision in the iliac fossæ. Satisfactory recovery. Patient continued in good health with both ureters intubated with small rubber tubes until his death five years after the operation. At autopsy, he had a hydro-ureter and hydronephrosis on both sides with a local carcinomatous deposit surrounding the right iliac vessels and ureter.**

|| This is the only case of transperitoneal total cystectomy in this series.

*Already published in technical supplement in *Urological and Cutaneous Review*, vol. iii, p. 4, 1915.

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S. R., male, fifty-eight years of age. Trouble began in September, 1914, with frequency of urination associated with pain, and one attack of hematuria.

January 26, 1915, cystoscopy showed bullous oedema around the posterior circumference of the neck of the bladder with extensive tumor formation on the posterior wall. Rectal examination showed a slightly enlarged prostate and in median line just below junction of prostate and of bladder a small stony hard mass; another somewhat hard mass in the position of the right seminal vesicle.

Pre-operative Diagnosis.—Malignant growth of prostate and neck of bladder.

January 27, 1915, abdomino-perineal prostatic cystectomy extraperitoneally. Bladder was exposed extraperitoneally. To confirm the diagnosis of malignancy, the bladder neck was palpated and found indurated. To make doubly sure, a small opening was made in the bladder and the interior palpated. Hard infiltrating masses were felt in the posterior wall running down to the neck. Bladder incision was closed, and as no iliac glandular involvement was detected, a typical extirpation of the bladder was done, and the membranous urethra was cut through after making a perineal incision. The left ureter was found dilated whereas the right was normal. The bladder and prostate with seminal vesicles and perivesical fat were removed in one piece. The two ureters were brought out through the abdominal wall and attached with a couple of sutures so that they projected beyond the level of the skin about one-half inch. To relieve all tension on the ureters, they had previously been liberated for three to



FIG. 1.—Case II, showing extensive involvement of the bladder down to the neck with removal of the bladder and prostate and posterior urethra in one piece. Anterior view.

four inches retroperitoneally. Following their attachment to the skin, a No. 6 fr. catheter was introduced into the right ureter, and a small drainage tube was introduced into the dilated left ureter. Median incision was closed in layers, drainage at lower angle.

Kidneys drained satisfactorily through the ureters, patient making an uneventful recovery, and functional test on February 18, 1915, showed 25 per cent. phthalein on the right side and 12 per cent. on the left.

By March 8, 1915, wounds were almost completely healed and the projecting ends of the ureters had sloughed away making healthy looking mucocutaneous fistulas. The rubber tubes were changed regularly, and the pelves and ureters were washed out several times each week.

On March 27, 1915, the patient was discharged wearing a urinal into which both ureter tubes emptied, a small-sized rubber drainage tube having been introduced a few weeks after the operation into the right ureter in place of the original ureter catheter as this ureter had gradually dilated adequately.

Specimen removed at operation showed a diffusely infiltrating tumor in the trigone and paratrigonal regions extending submucously over a considerable distance. There were several prominent hard nodules of carcinoma low down in the mid-line at the neck of the bladder as well as lateral to trigone. In the vertex of the bladder were numerous further masses of carcinoma which varied in size from a split-pea to large lima beans. The prostate proper seemed uninvolved.

Pathological Diagnosis.—Infiltrating papillary carcinoma.

Following discharge from the hospital, patient was regularly observed in the dispensary. Subsequently, he entered the Montefiore Home.

April 17, 1916, patient was in excellent health and was shown at the G. U. Section of the Academy of Medicine.

November, 1919, he was still in excellent health, almost five years after the operation.

In January, 1920, patient died at the age of sixty-three.

Post-mortem examination revealed a local carcinomatous deposit in the right pelvis, chronic pulmonary tuberculosis, and a recent tuberculous broncho-pneumonia with miliary tuberculosis in the right middle lobe.

Comment.—In this patient, a very extensive infiltrating growth involving the trigone both at the neck of the bladder and at the ureteral regions, was removed by total cystectomy and prostatectomy by the combined operation. The ureters were attached to the skin in both iliac fossæ and intubated. The patient was made comfortable and lived five years without any great annoyance, and finally died of a flaring up of an old tuberculosis of his lungs. Autopsy showed that there was a quiescent carcinomatous focus in his right pelvis.

CASE III.—Total cystectomy for extensive carcinoma involving base and neck of bladder; partial prostatectomy; implantation of the ureters in the skin of iliac fossæ. Satisfactory recovery from operation. Death nine and one-half months after operation. No autopsy.**

W. C., male, sixty-two years of age, admitted to Mount Sinai Hospital May 11, 1915, giving a history of eight months of urinary trouble, frequency, pain and hematuria. General condition poor. Urine contained albumin, red cells and granular casts.

Cystoscopy showed a papillary growth of left wall, base and neck of bladder with extensive œdema; picture typical of carcinoma. By rectal palpation definite induration could be felt in the base of the bladder reaching down to the prostate.

Pre-operative Diagnosis.—Infiltrating papillary carcinoma of bladder involving neck; possibly also adjacent prostate.

May 15, 1915.—A complete extraperitoneal cystectomy and partial prostatectomy for carcinoma of the neck of the bladder was performed; implantation of ureters in skin. Operation was done through a typical suprapubic median incision. Exploratory palpation confirmed the presence of indurated carcinoma as seen cystoscopically. The bladder was freed, vessels on either side being tied on either pelvis wall with three or four ligatures. The right ureter was exposed and found to be normal, whereas the left ureter was much dilated. After separating the bladder with attached seminal vesicles and perivesical fat down to prostate, the latter was separated from its bed, making a pedicle from the prostate, and two heavy silk transfixion sutures were passed through the prostate and tied on either side. This allowed of a bloodless section through the prostate proximal to the silk ligatures. The bladder and two-thirds of prostate were then delivered. The ureters were attached to the skin in the iliac fossæ near the anterior

** Already published in technical supplement in *Urological and Cutaneous Review*, vol. iii, No. 4, 1915.

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superior spines, and a catheter was introduced into each ureter. The median incision was closed in layers with adequate drainage at lower angle. Despite the patient's poor condition, he stood the operation very well.

Pathological Diagnosis.—Infiltrating carcinoma.

The post-operative course was satisfactory except for some temporary leakage alongside the small catheters in the ureters. After the ureters had dilated, rubber tubes were introduced and the leakage ceased almost completely.

On June 29, 1915, the right kidney secretion showed many clumped white cells, an occasional red cell, urea .8 per cent., phthalein in two hours 7.5 per cent. The left kidney showed urea 1.5 per cent., many non-clumped white cells, no red cells, phthalein in two hours 10.5 per cent.

Patient was discharged from the hospital with tubes in his ureters but he allowed them to fall out and to remain out of the ureters and had to be readmitted in November, 1915. His general condition was poor. There were no signs of metastases or local recurrences. He was comfortable and in no distress. Subsequently he was admitted to Montefiore where he died the end of February, 1916. No definite tumor masses could be recognized, the pelvis being free. There was a suggestion of metastasis in the inguinal glands. At Montefiore the patient's general condition gradually declined up to his death.

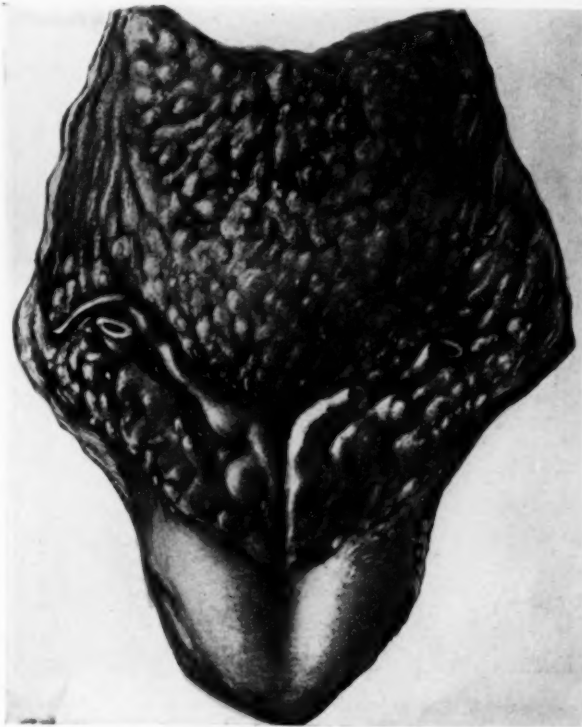


FIG. 2.—Case II, showing the prostate, seminal vesicles and posterior aspect of the bladder removed in one piece.

Comment.—This patient was sixty-two years of age at the time of operation and the poorest risk that has been submitted to such extensive operative procedure. Nevertheless he stood the operation well and was rendered comfortable for nine months or more, until his death.

CASE IV.—Total cystectomy for extensive infiltrating leiomyosarcoma of the bladder. Discharged six weeks after operation with wound closed; ureters draining well, a large dose of radium having been applied to the stump of prostate. Seven weeks following discharge, local recurrence of sarcoma at lower angle of wound, and subsequent death.

L. G., male, forty-nine years of age, admitted to Mount Sinai Hospital October 11, 1919, complaining of hematuria which had recurred on and off during the last year. He had been treated previously for bladder trouble in 1914–1915. In 1918 he passed clots of blood.

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At cystoscopic examination, it was difficult to enter the bladder. There was four ounces of residual urine, and an extensive necrotic, papillary looking neoplasm was seen on the left lateral and anterior walls. By rectum, a hard nodular infiltrating tumor could be felt coming down close to prostate. Specimens removed suggested a malignant papillary growth.

In view of the extent of the growth, it was considered very likely that a total cystectomy would be indicated and a written consent ‡ was obtained from the patient.



FIG. 3.—Case II, showing two tubes running to pelvis connected by a "Y" tube and emptying into an improvised urinal.

an adult fist, infiltrating all layers of the bladder wall down to the neck, the right wall of the bladder being spared.

The convalescence from this operation was rather stormy. The exploratory opening of the peritoneum which had been sewed, tore open, and a small loop of intestine and omentum prolapsed but was easily replaced without any peritonitis developing. The ureter catheters were changed on the tenth day. On the twelfth day, No. 10 rubber tubes were introduced into the two ureters, and a large dose of radium was applied to the prostate for ten hours. On November 30, 1919, the patient was out of bed, the wound granulating slowly. Toward the end of December a nodule appeared in the wound which was excised and which proved to be metastatic leiomyosarcoma. At this operation there was a secondary suture of the old wound which healed satisfactorily.

The patient went home January 12, 1920, with the wound closed, but as he had difficulty in taking care of himself, he returned to the hospital in February, 1920, with a rapidly growing sarcoma in the lower angle of the wound. His general health was

‡ To avoid any legal complications, a written consent has regularly been obtained before operation on all these cases.

November 14, 1919, the bladder was exposed and felt to be infiltrated on the left lateral, posterior and anterior walls all the way down to the prostate. In view of the age of the patient and the extent of the disease, it was decided to proceed with a total cystectomy rather than to stop at a suprapubic cystostomy even though the blood chemistry showed a marked increase in all the nitrogenous constituents.

The unopened bladder was removed and the prostate was cut across with the cautery. The ureters were brought out in the iliac fossæ and intubated. The wound was bathed in alcohol. During the operation a small tear had been produced in the bladder with the escape of some necrotic tumor tissue and foul urine.

Microscopic report on the bladder was leiomyosarcoma, the tumor being as big as

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much worse than on his discharge from the hospital, and the patient died February 17, 1920.

Comment.—In this patient a rapidly growing sarcoma of the bladder wall was removed under the impression that we were dealing with a carcinoma. Despite the apparently complete removal of the bladder and retrovesical infiltrated fat, it was impossible to eradicate the disease *in toto*, and though the patient made a comparatively good recovery from this most malignant type of tumor, a local recurrence developed which ended fatally, a little more than two months after the total cystectomy and partial prostatectomy.

CASE V.—Total cystectomy and partial prostatectomy for multiple papillomata and papillary carcinomata with infiltration in the bladder wall involving the neck, right ureter region and left wall bladder; implantation of the ureters in the skin of the iliac fossa. Satisfactory recovery from operation despite post-operative pyelonephritis. Two and one-half years after operation, owing to difficulty in passing tubes up right ureter, a right nephrostomy had to be done, the left kidney continuing to drain well through the rubber tube but a small stone developed in the left kidney pelvis. The right kidney continued to drain well after the nephrostomy. March, 1929, patient alive and general condition excellent. §§

J. R., male, thirty-five years of age, admitted to Mount Sinai Hospital March 23, 1925, with a history of fifteen months intermittent hematuria. He had lost considerable weight.

Rectal examination disclosed a large indurated mass made up of bladder base and prostate which was definitely ballotable suggesting a neoplasm of both organs. Functional kidney tests were satisfactory. X-ray of the genito-urinary tract was negative. Cystogram showed an irregular bladder with the neck of the bladder raised above the symphysis. An air-cystogram showed an irregularity which suggested the presence of numerous tumors projecting into the bladder cavity.

Cystoscopy showed a contracted lumen holding three and one-half ounces. The bladder was full of papillary tumors, partly necrotic and partly fluffy. The left posterior wall seemed to be free from tumors. The cystoscopic diagnosis was papillary carcinoma with multiple tumors.



FIG. 4.—Case V, showing extensive papillary carcinomata and multiple papillomata reaching into the neck of the bladder. The bladder wall is enormously thickened, giving the impression that the whole wall was infiltrated. This hypertrophy of the bladder wall was most misleading, and it is possible that in this case more conservative methods might have succeeded had we not been misled by the palpatory findings.

§§ Case published in part in the ANNALS OF SURGERY, p. 427, March, 1926.

March 27, 1925, having obtained permission for a total cystectomy, the bladder, seminal vesicles and upper part of the prostate were removed in one piece. A typical median suprapubic approach was used. The peritoneum was opened and the viscera explored for metastases. As none were found, the peritoneum was closed and the bladder mobilized. The ureters were identified and separated from the large thickened bladder. On palpating the bladder, it felt like a most extensive infiltrating growth. The prostate was freed, transfixed near its apex, and cut across with a cautery. The bladder, upper half of the prostate and seminal vesicles were removed in one mass, and the ureters were freed and brought out extraperitoneally in the iliac fossæ where they were intubated. On opening the bladder after its removal it was found to consist of a very thick wall, the organ in places œdematous, and the seat of multiple large and small papillary growths, the largest situated near the right ureter.

The microscopic examination of one of these growths near the neck of the bladder, whose base was very hard, showed papillary carcinoma. Other tumors examined showed benign papilloma. The bladder wall itself, which felt most extensively infiltrated, showed no malignant infiltration, the thickening apparently having been due in part to the hypertrophy and in part to the œdema except at the site of the definite infiltrating papillary growth at the neck.

Post-operative pyelonephritis developed with chills, and colon bacilli temporarily appeared in the blood. Both ureters drained well, and following the transitory attacks of pyelonephritis on each side, the urine became fairly clear and the patient left the hospital with both ureters intubated.

Functional examination of the kidneys showed satisfactory output of phthalein and indigocarmine. Two rubber tubes were connected with a "Y" tube and these emptied into a urinal which the patient carried within his trousers. The patient was fairly comfortable. There was practically no leakage alongside the tubes. The patient continued to do well though there was some trouble from time to time in passing large 12-14 fr. rubber tubes up the right ureter. As the result of repeated attempts, traumatism led to peri-ureteritis, and in the fall of 1927, as it was impossible to introduce even a catheter up the right ureter, to save the right kidney a right nephrostomy was done. There was some trouble in keeping the patient's urine acid, and though the tubes in his ureter and kidney had been repeatedly and regularly changed, phosphatic incrustations on the tube, despite urotropin and acidifiers, repeatedly developed.

By 1927 a small stone had formed in the left kidney pelvis which, however, caused no symptoms. Attempts to dissolve this stone with continuous irrigations of the left kidney pelvis—using hydrochloric acid as strong as 1/750—failed to dissolve this stone though it seemed (according to repeated X-rays) to diminish in size. The patient continued to drain well from his left kidney and from his right nephrostomy, and in March, 1929, he was last seen. His general health was excellent and there was no evidence of local or distant recurrences.

Comment.—This comparatively young patient suggested pre-operatively and on the operating table a most extensive infiltration of the bladder wall. The bladder contained innumerable small and larger papillomata and a papillary carcinoma at the neck of the bladder. A typical extraperitoneal total cystectomy was done, and though two and one-half years after operation there was some serious difficulty in passing tubes up the right ureter which forced us to do a nephrostomy, the patient continues in excellent health without any signs of any recurrences, draining through his left ureter and from his right nephrostomy without any signs of any local or distant metastases.

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CASE VI.—*Extensive infiltrating carcinoma of the bladder secondary to artificial cystitis. Right nephrectomy for calculous pyonephrosis; total cystectomy; partial prostatectomy; removal of lower end of right ureter with implantation of left ureter into skin. Radium seeds introduced into stump of prostate a few days after total cystectomy. Uneventful recovery. Tubes in left ureter changed every two to three weeks. Patient alive and working to date.*

M. W., male, forty-four years of age. This patient was first seen in 1911 for chronic cystitis with contracted bladder. To escape military service an injection had been made into the bladder which led to a chronic cystitis. Under treatment at that time, symptoms of bladder irritation were much improved.

In 1917 he had pain in the right kidney region, hematuria and marked frequency. By April, 1927, symptoms had become more severe and he had lost twenty-five pounds. X-ray showed a large stone in the right kidney.

He was admitted to Mount Sinai Hospital in June, 1927, where cystoscopy showed a large carcinoma of the bladder and a right pyonephrosis. In view of the purulent discharge from the right kidney it was deemed advisable to remove the kidney first and subsequently take care of the bladder condition.

In August, 1927, the right kidney was removed by Dr. A. Hymann, and after recuperating from this operation, the patient returned to Mount Sinai Hospital.

Re-cystoscopy in October, 1927, showed the bladder full of foul bloody urine and numerous clots. Capacity was eight ounces, and there was an extensive growth of the posterior, right and left lateral walls. By rectum it was possible to detect a hard infiltrating mass occupying the whole bladder region. In view of the extensive growth which reached apparently well down to the neck of the bladder, the patient was told he would probably require a total cystectomy, to which he consented.

October 21, 1927, the bladder was exposed extraperitoneally and found to be extensively involved, the walls infiltrating well down over the prostate. The bladder was opened and as it was evidently impossible to remove the growth except by total cystectomy and partial prostatectomy, the bladder cavity was gently packed with gauze soaked in alcohol, the incision closed, and an extraperitoneal excision performed removing the bladder and upper two-thirds of the prostate and seminal vesicles as well as the lower end of the right ureter from the place where it had been sectioned during nephrectomy for right pyonephrosis. The whole mass was removed in one piece, and the left ureter was brought out without any tension through a gridiron incision in the left iliac fossa. The wound was soaked in alcohol and the ureter was intubated with a catheter.

Pathological examination showed a very extensive infiltrating papillary carcinoma

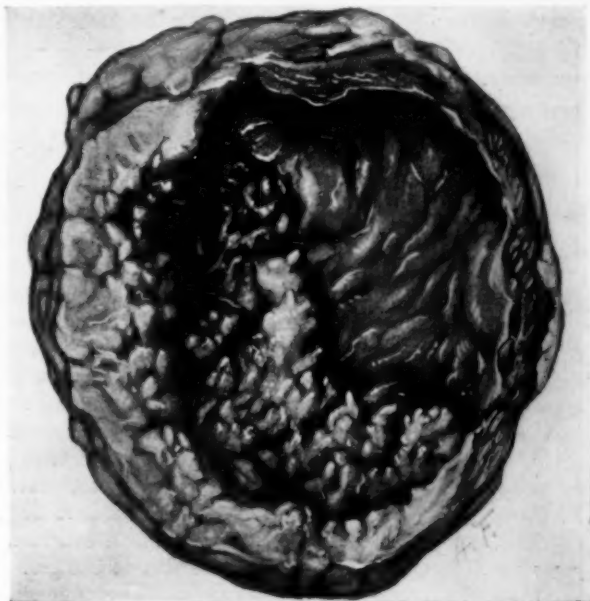


FIG. 5.—Case VI, showing extensive infiltrating papillary carcinoma involving the major part of the bladder with infiltration of the bladder wall, which in places is over one centimetre thick.

of the bladder with invasion of the capsule of the prostate. Only one seminal vesicle was attached to the specimen and it was not involved.

A few days following the above operation, a large number of radium seeds were introduced through the sinus down to the stump of the prostate. Patient made an uneventful recovery. Since the above operation his tube has worked very satisfactorily. The patient has remained perfectly well. His general health is excellent, and in March, 1929, patient was shown at a Joint Meeting of the Urological Society held in New York. Patient is well to date and able to be self-supporting.

Comment.—This comparatively young man, as a result of chronic irritation induced years before, developed chronic cystitis which led to dilatation of his ureter on the right side and secondary calculous pyonephrosis as well as to an extensive infiltrating carcinoma of the bladder involving the adjacent prostate. Nothing short of a total extirpation of the bladder and prostate promised him anything, and following the operation the patient made an excellent convalescence so that at the present date—one year and seven months following the operation—the patient is self-supporting and in excellent condition; the left kidney (on which he is living) is draining satisfactorily through a ureter tube.

CASE VII.—Extensive infiltrating papillary carcinoma of the bladder. Partial cystectomy of thickened bladder wall. Surface of mucous membrane showed three small papillary growths and the whole bladder was much thickened. Microscopic report showed diffuse infiltration of the bladder wall. Eleven days after preliminary operation, total cystectomy and partial prostatectomy with implantation of the ureters through two grid-iron incisions in the iliac fossæ. During the post-operative course, some difficulty introducing catheters into the ureters which led to attacks of pyelonephritis. After the ureters had dilated, rubber tubes were easily introduced, ureters easily taking 12-14 fr. size. Patient is well and general condition is excellent to date.

I. R., male, fifty-five years of age. Patient had been treated on and off for eighteen years for hematuria caused by a papilloma of bladder.

Under high frequency treatment tumors were readily destroyed but the patient was not adequately controlled, and in October, 1928, his bladder showed necrotic papillomata surrounding the left ureter region reaching down toward the sphincter involving the trigone and the left wall of the bladder. By rectum, no definite infiltration could be felt, and cystogram showed reflux up both ureters without any definite deformity of the bladder contour as well as no filling defect. X-ray of the lungs showed no metastasis.

October 11, 1928. *First operation.*—Pre-operative cystoscopy under anaesthesia showed the same contracted bladder which bled easily, with flat necrotic papillary masses as above. The left ureter orifice was open and the tumor reached close to this as well as within a half centimetre of the right ureter. At the neck of the bladder there were also definite tumor areas covered with exudate. By rectum, under anaesthesia, a definite mass could be felt in the base of the bladder reaching above the trigone suggesting an infiltrating tumor.

No consent to total cystectomy had been obtained though the question of the advisability of doing such an operation was discussed with the family physician.

At operation, bladder was exposed suprapubically. It was very adherent. The whole posterior wall felt thickened. The peritoneal cavity was opened and explored for metastases. None were found but an inflammatory omental mass was felt attached just behind the bladder. Perhaps this was part of the induration felt by digital examination through the rectum. The peritoneum was closed and the bladder freed, and then opened with an electric needle. The whole posterior wall felt much thickened and oedematous with hard

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and very small papillary irregularities; in other places, superficial ulcerations with incrustation. No definite tumor could be detected otherwise. The whole picture suggested a proliferative, ulcerative cystitis with infiltration of the bladder wall. A large section was removed from the posterior bladder wall for microscopic examination. At the conclusion of the operation, owing to the doubtful findings, it was deemed fortunate that we had not discussed total cystectomy with the patient and proceeded at the first step in doing a total cystectomy.

The patient did well after this operation though he ran some temperature, owing to the infected condition of his bladder and some perivesical inflammation.

The microscopic report of the specimen from the posterior wall of the bladder, which had been removed at operation, showed a rapidly growing diffuse infiltration of the whole wall with carcinoma.

The situation was then laid before the family. It was evident that nothing but a total cystectomy could remove the extensive disease in the bladder, and having obtained consent, on October 22, 1928, a total cystectomy and partial prostatectomy with transplantation of the ureters to the iliac fossæ was performed. This was carried out in the face of an open bladder with perivesical infection, and even though the patient was running some temperature.

The tissues about the bladder were more or less infiltrated. The peritoneum was rigid, making the exposure of the floor of the pelvis particularly difficult. The bladder incision made at the first operation which had been closed tore open and further infected contents spilled into the pelvic cavity. The ureters were bound down by periureteritis. The left ureter was twice normal size; the right ureter was about normal size. They were freed for about 5 inches retroperitoneally and then swung outward above the structures of the cord, and after cutting through the transfixed prostate, the ureters were brought out through gridiron incisions and intubated with No. 6 fr. catheters, the ureters being attached to the skin with silk, and the projecting ends of the ureters tied around to the ureter catheters with another piece of silk. The seminal vesicles were not removed with the bladder and upper half of prostate. Patient stood the operation very well and both ureter catheters were draining nicely. The central wound was closed with adequate drainage.

Two days after the operation there was a rise in temperature preceded by a chill and tenderness over the kidneys. The chills repeated themselves a number of times, and as the catheters began to swell, the drainage was less satisfactory and new catheters had to be introduced. Whenever catheters became occluded there was a rise in temperature. At times in changing these catheters during the first couple of weeks, the introduction of new catheters was most difficult. To dilate the ureters, filiform bougies of the Phillip's type were introduced into the pelves allowing the filiform end to curl up into the pelvis, attaching No. 10 silk catheters to same.

By November 19, 1928, it was possible to introduce on each side No. 12 fr. rubber catheters with multiple holes. Subsequently, No. 14 fr. rubber tubes were easily introduced and no more difficulty encountered.

On December 24, 1928, the patient was draining 122 ounces from the kidneys in twenty-four hours. His urine had come back to almost normal. The patient was up and about having been discharged from the hospital a week earlier. There was occasionally some discharge from the suprapubic incision which may have been from the prostatic stump, which was slow in healing over.

A recent last report from the patient shows his general health is excellent; he has lost no weight; his tubes are changed every two to three weeks; there is still slight drainage from the lower end of the median incision.

Comment.—This patient, who had been treated on and off for eighteen years for papilloma of the bladder, developed malignancy which infiltrated

his whole bladder wall with comparatively slight mucous membrane involvement. It was originally decided that a complete cystectomy might be necessary but at exploratory operation, the slight involvement of the mucous membrane of the bladder suggested that a mistake had been made in the interpretation of the case. When the pathological report of an extensive infiltrating carcinoma (based on a large specimen excised from the posterior wall) came in, the question of total cystectomy was again raised, and with the consent of the family, this operation was done to give the patient, who

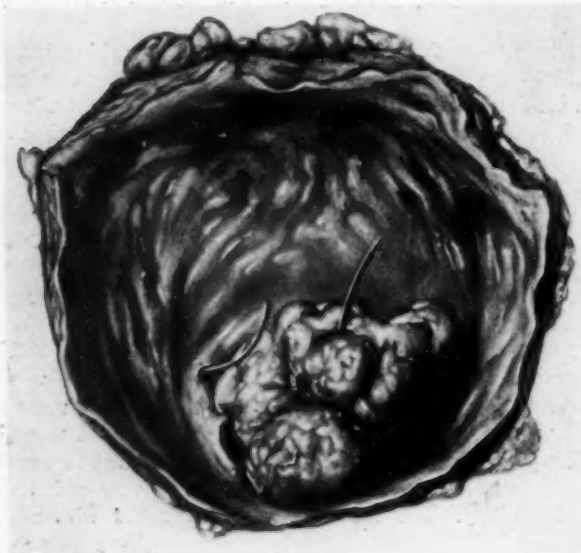


FIG. 6.—Case VIII, showing papillary and solid carcinoma invading the neck of the bladder, involving the left ureter and encroaching on the right; the whole trigone involved in the neoplasm.

otherwise was in perfect health, relief from distress and a possible chance of cure. Eleven days after the first operation, the second operation—total cystectomy and partial prostatectomy—was done. The patient made a satisfactory convalescence except for repeated attacks of pyelonephritis caused by poor drainage from the ureter catheters. As soon as the ureters were sufficiently large to admit of fair-sized rubber tubes, this condition was controlled and the patient was discharged to

his home in excellent condition. The patient to date remains well except for a slight discharge through a sinus which apparently leads down to his prostate.

CASE VIII.—Extensive papillary infiltrating carcinoma involving the trigone, the ureter on one side and encroaching upon the ureter on the other side, also reaching down to the neck of the bladder. Total cystectomy and partial prostatectomy with implantation of the ureters in the skin of the iliac fossæ. A large metastatic gland at the bifurcation of the iliac vessels on the right side which could not be removed. Numerous radium seeds introduced into this gland as well as into the stump of the prostate. Uneventful recovery. Patient discharged from the hospital three months after admission with both ureters intubated with rubber tubes, doing very well, and has remained well to date.

A. S., male, fifty-six years of age, admitted November 17, 1928, with a history of one year dysuria, frequency and hematuria. Last three weeks symptoms have been more severe and there has been pain in both kidney regions radiating down along ureters. During the day patient voids every half hour to one hour, and five times or more at night.

Cystoscopy without anaesthesia was unsatisfactory as patient's bladder was small and bled easily. A large solid and partly papillary growth was seen on the left wall extending into the trigone. It was more or less covered with phosphates. A large

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piece of the growth broke away and was extruded when patient squeezed against the cystoscopic sheath.

Under caudal anaesthesia, second cystoscopy made. Tumor was found to extend to the sphincter region covering the left ureter and reaching almost to the right ureter. It was partly solid and partly papillary; the solid portions were definitely sessile. In addition there was a prostatic enlargement, adenomatous in type. Bimanual examination showed a definite mass above the prostate with infiltration of the bladder wall on the left side.

Specimens removed during cystoscopy were reported as medullary carcinoma.

Patient's general condition was fair. Blood chemistry showed 25 milligrams urea. A consent for total cystectomy was obtained prior to operation.

November 30, 1928, with a diagnosis of extensive infiltrating carcinoma in the positions just mentioned, a total cystectomy and partial prostatectomy was carried out. After exposing the bladder extraperitoneally and packing the wound, the bladder was opened to explore. It was found that the tumor was too extensive to permit of a local resection, that the neck was involved with an infiltrating growth from the right side anteriorly to the left side posteriorly, that the left anterior, lateral and posterior walls were infiltrated through the trigone past the left ureter orifice. The bladder was packed with alcohol soaked gauze and the incision temporarily closed with heavy silk stitches. The bladder and prostate

were mobilized, the latter transfixed, and the prostate cut across with a cautery. The ureters were brought out in the iliac fossæ. In the right pelvic region at the bifurcation of the iliac vessels, a gland as large as a walnut containing metastatic carcinoma was encountered. As this could not be separated from its intimate attachment to the vessels, radium seeds were introduced into it, each containing two and one-half millicuries. In addition radium seeds were introduced into the stump of the prostate. The ureters were intubated with ordinary large ureter catheters, and the wound closed with drainage down to the prostate.

The patient made an uneventful convalescence. His phthalein output was repeatedly studied and each kidney delivered between 40 and 50 per cent.

By December 16, 1928, the ureters had dilated up sufficiently to allow the introduc-



FIG. 7.—Case VII, showing patient with two rubber tubes in ureters coming out of the iliac fossæ, united by a "Y" tube and emptying into an ordinary urinal attached to the left leg.

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tion of No. 12 fr. rubber catheters. These were easily introduced, there being no obstruction in the ureters.

December 26, 1928, the blood urea dropped to 15 milligrams.

January 28, 1929, patient had a mild attack of pyelonephritis which, however, did not disturb the kidney function.

February 2, 1929, the lower angle of the wound was still discharging a small amount of pus, apparently from the stump of the prostate where radium needles had been inserted.

May, 1929, patient has been regularly attending to the ureter tubes, having them changed every two to three weeks. Patient is still in excellent health and is comfortable.

Comment.—This patient had an extensive infiltration of the trigone and neck of the bladder and had been suffering for over a year. With total cystectomy, his life had been made bearable, he was able to get around, and even though the local metastases (which have been treated with radium implants) will probably eventually lead to his death, for the time being he has been made comfortable.

BIBLIOGRAPHY

¹ Handbuch d. Praktischen Chirurgie, p. 754, 1922.

² K. Scheele: Zeitschrift für Urologie, vol. xvii, p. 65, 1923.

³ Handbuch Praktischen Chirurgie. By Garre, Kuttner, Lexer, sixth ed., p. 902, 1927.

⁴ Practice of Urology, vol. ii, p. 366, 1926.

⁵ Federoff, S. P.: Journal d'Urologie, November, 1926.

⁶ Zentralblatt für Chirurgie, p. 51, 1928.

⁷ Coffey: Surgery, Gynecology and Obstetrics, November, 1928.

⁸ Zeitschrift für Urologie, vol. xvii, 1923.

⁹ Papin, M.: Journal d'Urologie, vol. xx, p. 388, 1925.

DISCUSSION: DR. WILLIAM E. LOWER, of Cleveland, Ohio, said that his experience with total cystectomy had not been very satisfactory. He had done seven cases, with death in two before leaving the hospital. Both of the fatal cases were severe and in both the kidneys were rather badly infected. He did a two-stage operation in each case, first transplanting the ureters and later removing the bladder. In one case the patient lived two and a half years. During that time the man was able to go back to his work and economically presented a very good result.

In another case the man is still living but he has a metastasis and is having severe pain in his thighs. In the other cases the patients died from recurrence within a period of one and a half years.

Lately, instead of doing this extensive operation in these cases he had gone back to treatment with the X-ray and radium. About three or four years ago he felt that the X-ray treatment in these cases was not worth while. He was just about to discontinue it when the department was reorganized and a clinician was put in charge of it instead of turning it over to the X-ray man who simply took X-ray pictures and who was much more interested in that phase than he was in the treatment. The profession is now getting more encouraging results.

Doctor Portmann, who has charge of the Department of X-ray Therapy, is called into consultation on these cases. He examines the cases and treats them individually, just as a surgeon operates upon a case only after examina-

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tion. He strictly individualizes his cases; that is, he does not follow out any particular routine. The result is that in many cases the patients have been greatly relieved and have gone to work, and in several instances after two or three years are free from local recurrence. He did not know whether he was going to have any cures in these cases, but he knew that economically these patients are put into a condition which could not be attained in any other way. They are not annoyed by having to wear some type of urinal.

Doctor Beer has been one of the pioneers in advancing the treatment of tumors of the urinary bladder. It is possible that the technic that he describes may be the treatment to use in these desperate cases. The speaker felt very much encouraged with the results he was getting with the X-ray, sometimes combined with radium. One often does not get permission to do this extensive operation in the cases in which the disease is still in its early stages.

DR. ARNOLD SCHWYZER, of St. Paul, Minn., said that in some cases of carcinoma of the bladder one can have rather long-lasting relief by energetic radium application. He had seen this relief to last over two and a half years. But there are conditions where radium does not give relief. For instance, he mentioned a case which had been operated upon twice for multiple papillomata of the bladder. The patient was most miserable. There was a papillary carcinoma filling the whole bladder. He was very glad to be able to do the excision of the bladder extraperitoneally.

Doctor Beer has mentioned that there is comparatively rarely an involvement of the deeper parts of the bladder wall. The neoplasm, especially of the papillary type, is in the mucosa, the submucosa and the superficial layers of the muscularis. Thus one can make a subperitoneal excision of the bladder, the peritoneum being dissected away at times with remarkable ease.

In this particular case he removed the bladder together with the whole prostate. After freeing the bladder suprapubically he tilted the patient into the lithotomy position and through a perineal opening clamped the tissues below the prostate. This enabled him to get the whole prostate out together with the bladder. There was no undue bleeding. The ends of the ureters had to be resected for about one inch. A pseudo-bladder formed in the subperitoneal space and finally he had quite a good manner of draining the urine through the urethra into a urinal.

DR. EDWIN BEER (in closing the discussion) said that one must admit this is far from an ideal method of taking care of the patients; but, the situation is desperate and the patients suffer so much, and up to date no certain relief can be offered these patients except by total removal of the upper half of the prostate and the whole of the bladder. If the ureters could be transplanted to the bowel with safety, without a much higher mortality than he had by transplanting into the skin, it would be a much more satisfactory method. Anybody who has exposed ureters that have been blocked by growths at the neck of the bladder knows that the ureters are so large that a real good and safe anastomosis with the sigmoid is practically out of the question in the majority of the cases.

CHRONIC CYSTIC MASTITIS OF THE DIFFUSE,
NON-ENCAPSULATED, CYSTIC ADENOMATOUS TYPE *

(SHOTTY BREAST)

By JOSEPH COLT BLOODGOOD, M.D.

OF BALTIMORE, MD.

HISTORICAL.—In December, 1906, in *Surgery, Gynecology and Obstetrics* (vol. iii, p. 721) I made a report on this rare form of chronic cystic mastitis under the title "Senile Parenchymatous Hypertrophy." At that time it was known in the literature chiefly as Schimmelbusch's disease, Reclus's disease, diffuse papillary cystadenoma, and, by Warren, abnormal involution, or "cobblestone breast." All of the writers at that time, twenty-three years ago, were of the opinion that this was a precancerous lesion, and the probability of cancer being associated with it was at least 50 per cent. Continuous study of this lesion of the breast in the Surgical Pathological Laboratory of the Johns Hopkins University and Hospital has forced upon us the conclusion that it is not a precancerous lesion, but cancer may develop in it just as it appears in the breast during pregnancy or during lactation, or in the breast of any female between the ages of twenty-five and the end of life. Cancer in chronic cystic mastitis is an incident and not a consequence of this diffuse pathological process. At the present time we do not know the etiological factors in cancer of the breast, nor those of chronic cystic mastitis.

In November, 1921 (*Archives of Surgery*, vol. iii, p. 445), in reporting, with ninety-one illustrations, our entire experience of 350 cases, there were exactly thirteen of the Schimmelbusch or Reclus type. In fact, this type of diffuse, non-encapsulated papillary cystadenoma was the least frequent of the eight groups in which this disease naturally divided itself. In the interval between 1906 and 1921, a period of fifteen years, I had become convinced that this type of chronic mastitis was not a precancerous lesion, and as a matter of fact, among the thirteen examples of which we had sections and tissue there was but one who died of cancer, and this was the only one in which the microscopic study revealed fully developed cancer. I am inclined to the view now that this case was not cancer in diffuse, non-encapsulated papillary cystadenoma, but an example of acute carcinoma of the breast with a clinical picture of diffuse mastitis.

The sections of these thirteen cases have been submitted to many pathologists, and the result has always been a difference of opinion on the twelve cases that we now look upon as benign, while in the one case—dead of cancer—all agreed that the microscopic picture was typical of cancer.

The pathology of the first case observed at the Johns Hopkins in 1892 is recorded in Doctor Welch's own handwriting and describes the gross and microscopic picture of what we now know as diffuse papillary cystadenoma.

* Read by title.

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In this case the glands were not involved, and the patient lived more than thirty years.

In 1899 I had my first opportunity to palpate the breast and record the gross and microscopic pathology. The diagnosis then was papillary cystadenoma. Only the breast was removed; the patient was followed for more than ten years and there were no signs of recurrence. In 1901 I was able to study with my colleague, Dr. John M. T. Finney, a most typical example of this shotty breast, and Mr. Horn has left us a painting of which Fig. 3 is a photographic reproduction. The patient allowed Doctor Finney to remove but one breast. Our diagnosis was Schimmelbusch's disease with a small zone of cancer, shown in the illustration. This case was the basis of my report in 1906, five years later. We now know that the area of cancer in that breast was simply an atypical picture of papillary cystadenoma.

As our experience grew and we were able to follow this small group and restudy the pathology, we began to realize that this diffuse form of chronic cystic mastitis was apparently just as benign and no more of a pre-cancerous lesion than was the breast, the seat of single or multiple blue-



FIG. 1.—(Pathol. No. 30521.) The proper position for inspection and palpation of breast. In this instance the inspection showed a clinically malignant tumor of the left breast; retraction of nipple and retraction and dimpling of skin. On palpation an indurated mass beneath nipple.

domed cysts, or cysts of the galactoceles type, or those with dilated ducts beneath the nipple (the varicocele tumor of the breast), or the "lumpy" breast, in which the definite and indefinite multiple areas present in both breasts were due to one or more minute cysts or dilated ducts. As a matter of fact chronic cystic mastitis is a very cosmopolitan disease—it presents a number of definite clinical pictures on palpation. Its gross appearance, when a single area or the entire breast is studied, varies with the changes in the parenchyma of the breast, and the varying amount of normal breast, stroma, fat, and the varying amounts and distribution of dilated ducts, minute cysts, big cysts, whether blue-domed or of the galactoceles type, large and small—usually small—intracystic papillomas, and areas of papillary cystadenoma. In addition, there may be distinct interstitial chronic mastitis with pressure destruction of the parenchyma like the senile breast. With rare exceptions the clinical picture of cystic mastitis is benign. In a small per cent. the nipple may be retracted and now and then secondary infection

with its mastitis may produce dimpling of the skin, atrophy of the fat, and even redness and infiltration of the skin. It is the microscopic variants that have produced confusion with cancer. In my article in the *Archives of Surgery* for 1921, I have reproduced forty-nine different microscopic pictures showing changes from the normal breast through all the variants under the term lactating breast, senile breast, fibro-adenoma, intracanalicular fibro-adenoma, aberrant adenoma, irregular adenoma, cystic adenoma, small solid adenoma; solid adenoma microscopically suggesting cancer; chronic mastitis from compression of the wall of the big cyst resembling cancer; various forms of epithelium-lined cysts, of cysts with papilloma, of inclusions of papillary cystadenoma described by Ewing as of sweat gland origin; all types



FIG. 2.—(Pathol. No. 12586.) Photograph of patient with shotty breast. Intermittent retraction of left nipple four years; permanent four months. Intermittent retraction of right nipple four months. Clinical diagnosis (Bloodgood) in 1912: Cancer in bilateral Schimmelbusch's disease. Complete operation on both sides. Microscopic study: Glands, no metastasis. Revised diagnosis: Diffuse, non-encapsulated papillary cystadenoma. This patient lived free from recurrence fifteen years.

of dilatation of ducts with periductal inflammation; all the types of papillary cystadenoma, those distinctly benign and others suspicious of malignancy; the large solid duct adenoma which must be distinguished from comedo carcinoma; the combination of chronic mastitis and chronic cystic mastitis which is often associated with destruction of the basement membrane and invasion of the epithelial cells into the surrounding tissues.

Every term repeated here will be found in the literature of this breast disease. Since the second edition of Velpeau, with his description of the microscopic appearance of breast tumors up to the present time, pathologists have been finding difficulty in distinguishing in the microscopic picture between atypical epithelial or parenchymatous activities, from definite carcinoma, and through all these years one sees the terms adenocarcinoma, malignant adenoma, areas suspicious of malignancy, malignant intracystic papilloma.

After making this report in the *Archives* in 1921 I felt convinced that we were justified in being just as conservative with the Schimmelbusch and Reclus type of chronic cystic mastitis as with the definite single or multiple blue-domed cyst.

In November, 1922 (*Southern Medical Journal*, vol. xv, p. 907), I made a report on the clinical picture of this diffuse type of chronic cystic mastitis and ventured to suggest the name "shotty" breast. In the one year since

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the appearance of the contribution in the *Archives of Surgery* I had observed and recorded clinically six examples of the bilateral shotty breast, the clinical picture in which was apparently identical with five of the thirteen cases reported in the *Archives of Surgery* in 1921. Unfortunately in the remaining eight cases there was no note on the other breast. In one which proved to be malignant and died of cancer there is no positive evidence of involvement of the other breast. In a second case, one breast had been removed for cancer three years previously. Two cases that were examined later had definite shotty breasts, and letters from two others record disappearing tumors in the remaining breast. This suggests that in the majority the lesion was bilateral, but was not so recorded in the history.

The Increasing Prevalence of Chronic Cystic Mastitis in 1929.—In the seven years since the report in 1922, I have more than one hundred cases of shotty breast in which about six have been subjected to operation for indications which will be discussed later. In three a cancerous lump was present in the breast, the seat of diffuse papillary cystadenoma.

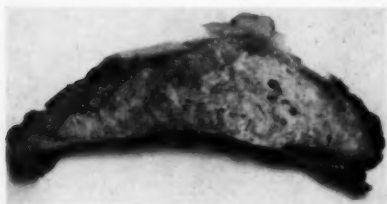


FIG. 4.—(Pathol. No. 26046.) Photograph of formalin specimen in 1920. This shows typical, diffuse, non-encapsulated papillary cystadenoma and dilated ducts filled with thick, grumous material. I made a clinical diagnosis of bilateral shotty breast of the benign type, in 1920, and removed both breasts. The patient is living in 1929 without signs of any recurrence. Since this date I have not subjected to operation patients exhibiting this clinical picture, and have now a record of more than one hundred such cases. Photo by Herman Schapiro.

Up to 1900, in our records in the laboratory, the per cent. of malignancy in breast tumors was 80, and the per cent. of benign lesions of the breast in which operation was not performed was less than 1. In my own records today of the patients referred to me the per cent. of benign lesions, for which operation is not indicated, has increased from less than 1 to more than 65. Of the remaining 35 per cent. in which, on account of a definite tumor, operation has been performed, about 17 per cent. proved to be malignant and

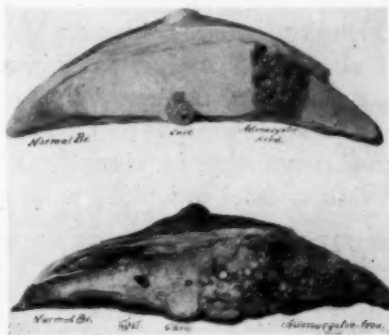


FIG. 3.—(Pathol. No. 3965.) Diffuse, non-encapsulated papillary cystadenoma. Clinically, bilateral shotty breasts, most marked in upper and outer quadrant of right breast. Removal of right breast only. Diagnosed cancer in 1901. Patient refused further operation, and lived twenty years. Photograph of painting by Mr. Horn made in 1901.

In the cases in which there was no definite lump, but only the clinical picture of bilateral shotty breast and in which operation was not considered indicated, there has developed as yet no example of malignant disease, and I have no evidence that these women run any more risk of cancer than any other woman of the same age.

The incidence of chronic cystic mastitis in all its groups increases rapidly when women report within a month, because attention to the breast has been called by pain, discharge from the nipple, lump or tumor, enlargement of one or both breasts.

18 per cent. benign. That is, the operative cases run about fifty-fifty. This week in my clinic the benign operative cases of the breast were 75 per cent.

The largest number of women who seek advice the moment they are warned by anything unusual in regard to the breast, come because of pain or a lump, or an enlargement. When carefully studied, we find that the largest findings are lumpy breasts which are usually due to chronic cystic mastitis. Shotty breasts are increasing in relative proportion, also dilated ducts beneath the nipple and the blue-domed cysts.

Surgeons must be on the look-out, if their patients come from an enlightened community, for chronic cystic mastitis. This is the most common lesion in breast cases in which the symptoms are of one month's duration or less.

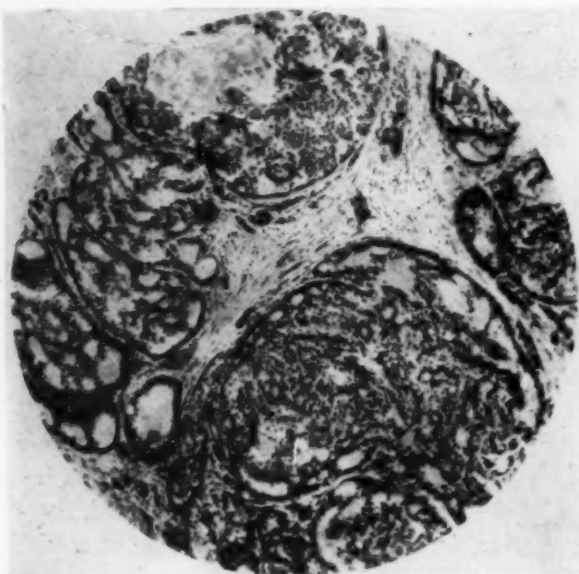


FIG. 5.—(Pathol. No. 3965.) Section from specimen shown in Fig. 3. In 1901 this was diagnosed *adenocarcinoma*. The diagnosis was later changed to papillary cystadenoma.

Clinicians and surgeons must learn the palpation or the so-called physical examination of the breast in women of all ages. The moment one feels a definite single lump the condition of the remaining breast is of no value in the differential clinical diagnosis unless there are other definite lumps in the same or opposite breast. With the rarest exceptions, multiple definite lumps rule out malignancy, or if malignant, rule out curability. If one, therefore, finds a single definite lump in the breast of a woman over twenty-five years of age

and, in addition, finds lumpy breasts or bilateral shotty breasts, or dilated ducts beneath the nipple, this must not influence the indication for operation any more than the signs of pregnancy or that the woman is nursing a child. When there is a definite single lump with no signs of malignancy clinically, it must be explored and the differential diagnosis made while the patient is on the operating table, from a frozen section, best made without hardening of the tissue by boiling in formalin and with Terry's polychrome methylene-blue stain.

The two greatest difficulties today in clinics in which the communities have been instructed on what to do the moment the attention is called to the breast, are: First, palpation—find the definite lump, learn to recognize the shotty breast, the lumpy breast, the dilated ducts beneath the nipple; second, inspection—learn to recognize at once any irritation of the nipple which if overlooked may lead to Paget's cancer of the nipple and, third, if

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there is a definite lump, provide the operating room with a pathological team which will consist of one or more individuals who can make and stain a frozen section and properly interpret it through the microscope within five or ten minutes. The surgeon always has the safe rule to follow—to do the complete operation for malignancy if there is any doubt. My records show that clinicians and surgeons who have not had the experience to allow them to improve their sense of touch are overlooking definite lumps which are cancer in the early stage, and are postponing operation until the chances of a cure have been reduced from 70 to 20 per cent. because of the involvement of the glands. On the other hand, at operation, the inability of their pathological team to distinguish chronic cystic mastitis from cancer is increasing the number of women whose breast or breasts have been removed unnecessarily. This is the least dangerous mistake. Or, a doubtful tumor is removed and is sent somewhere for diagnosis, or is diagnosed in the clinic in from one to ten days, and then the complete operation is performed. If the tumor is really cancer the patient's chances of a cure are reduced by this delay. If the tumor is not cancer the woman loses her breast. If the tumor is

cancer and is diagnosed benign and the complete operation is therefore postponed until recurrence or is not performed at all, the woman loses her life. I have just seen in my clinic a woman who gives the following history: Six months ago a lump of a few weeks' duration was removed and *not* submitted to microscopic study. The operator diagnosed it a benign cyst. A tumor reformed near the scar. It was excised by another surgeon. The diagnosis was not rendered for two days, and then she had a complete operation with post-operative radiation. And now, she has a little lump in the remaining breast and is naturally anxious to have a different experience.

The Clinical Picture of Bilateral Shotty Breast.—I have already noted that since my publication in 1922 I thought I had one hundred examples of bilateral shotty breast. Today there have been taken from my files among

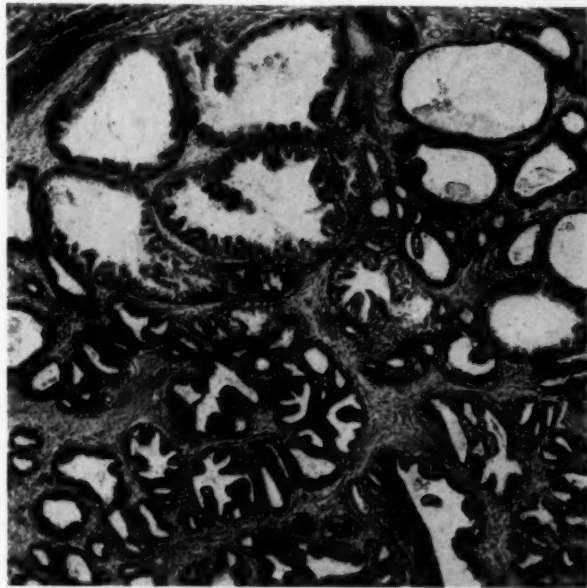


FIG. 6.—(Pathol. No. 21770.) An area of diffuse papillary cystadenoma in the wall of a blue-domed cyst excised by me in 1916, and there is no recurrence in this breast in 1929, thirteen years later. In the gross and under the microscope, this area differs very little from Fig. 5. Remember, this breast, the seat of this disease, was left.

the benign lesions of the breast for which operation was not performed ninety-seven histories. The first is dated December 1, 1920, the last March 18, 1929. There are about fifteen cases not in their envelopes which are out for various reasons, such as letters to be answered, etc. So there are more than one hundred cases.

In 1923 I find eighteen histories of this lesion. What a contrast with 1890 to 1921 when we could collect but about fifteen cases, of which thirteen were subjected either to the complete operation for cancer, or the complete removal of one or both breasts.

In rereading these histories and what I have published on this subject since 1921 I find that the clinical picture of the shotty breast remains

unchanged, but our knowledge of its existence and our ability to recognize it on palpation have greatly increased, and the records show that many individuals in the medical profession are able to interpret this group of chronic cystic mastitis as well as the other clinical groups.

Diffuse adenocystic or papillary-cyst-adenomatous type of chronic cystic mastitis, the disease known in the old literature as Schimmelbusch's or Reclus's disease and so clearly pictured in Fig. 3 from a painting made by Horn, a colleague of

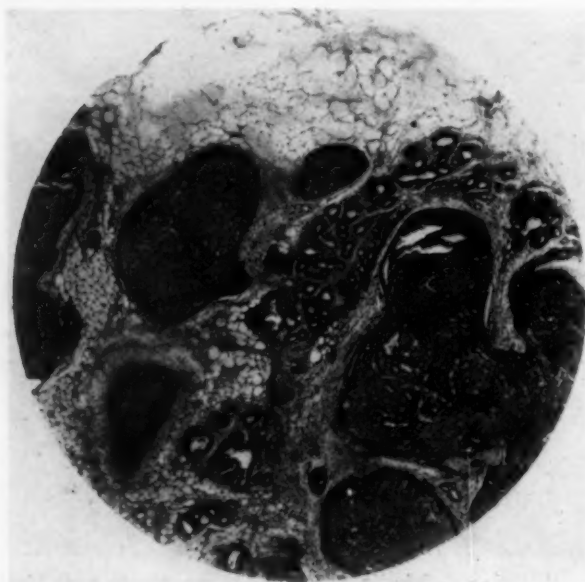


FIG. 7.—(Pathol. No. 26650.) An area of large alveolar duct adenoma found in the wall of a blue-domed cyst, excised in 1920. No recurrence in 1929. Sections of this kind are common in Schimmelbusch's disease and are usually diagnosed carcinoma or adenocarcinoma, or duct cancer.

Broedel, in 1901, can be recognized only on palpation. One breast may be larger than the other, but this asymmetry of the female breast is the rule rather than the exception, and any one of the diseases common to this breast may be present in either the smaller or the larger. But in the bilateral shotty breast, the larger breast is always the one in which the disease is further advanced. Discharge from the nipple is present in a small per cent. of the cases. Retraction of the nipple of the intermittent type, unilateral or bilateral, is practically diagnostic, but I have observed it in less than 10 per cent. of the cases. Discharge from the nipple is not diagnostic. Irritation of the nipple, of any type, seen on inspection, is not diagnostic. This may be present in any type of disease of the breast, benign or malignant. Dimpling or red skin suggesting malignancy is much less frequent than in the varicocele tumor

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of the nipple due to dilatation of the ducts. But in 1921, in the *Archives of Surgery*, I reproduced a colored illustration of patient and specimen, illustrating the clinical picture of cancer due to an infection of a cyst in Schimmelbusch's disease (Figs. 30 and 31), and Fig. 29 shows retraction of one nipple.

When one palpates the breast, as shown in Fig. 1, and feels each breast with one hand and feels the periphery first and palpates as if playing the piano, the shotty condition of the breast tissue is brought out at once. The normal breast of a boy or girl at puberty approaches the shotty breast, but the sense of palpation of the breast at puberty is one of firmness and distinct outline of the breast, while the shotty breast has this firmness and distinct outline in addition to the multiple minute shot-like nodules.

The firmness of the shotty breast is due to the increase of stroma and the distention of this stroma by the epithelial activity within the ducts and acini of the breast. The shot-like nodules are either epithelium-lined cysts, areas of papillary cystadenoma, or cysts filled with minute papilloma. Fig. 3 from the painting by Horn shows a more or less normal breast to the left, while the hemisphere to the right illustrates the involved area. Fig. 4 (Pathol. No. 26439) (*Archives*, Fig. 26) is a photograph of a formalin specimen which, in the fresh, resembles Fig. 3. It is

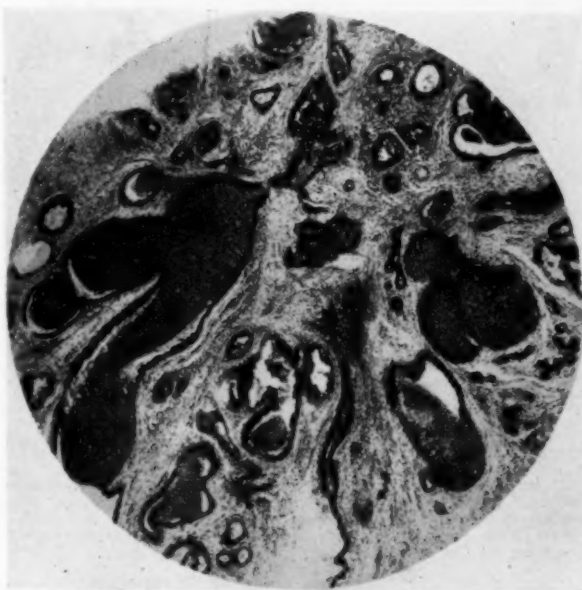


FIG. 8.—(Pathol. No. 1734.) Diagnosed adenocarcinoma in 1897. The tumor, clinically benign, was first excised; then, after microscopic study, the complete operation for cancer was done. The glands showed no metastasis, and there were no signs of recurrence for sixteen years. Apparently Figs. 7 and 8 are identical. In the case illustrated in Fig. 7 the breast was not removed.

almost impossible to preserve the fresh appearance of the diffuse Schimmelbusch disease of the breast, or the rare encapsulated cystic adenoma.

The prominent feature in all the cases of which we have any record is the shotty condition of the breast and its increased firmness as compared with what we might look upon as the normal breast. The next feature is a distinct edge like the smooth, round edge of the liver. The next is such a firmness of the breast that when you pick it up, it curves and palpates like a saucer with a thick edge. Shotty and nodular, increased density or firmness, distinct edge, and saucer shape describe this diffuse form of chronic cystic mastitis, from its earliest to its latest sign.

Since we have made most careful notes of palpation of both breasts we have no record of this disease as being unilateral. The fault in my contribution of a few cases in 1906 and thirteen in 1921, was the absence, except in the recent cases, of any note on the opposite breast, or, if there was a note, the failure to appreciate the presence of this disease in its earlier stages. It is, therefore, safe to say that the shotty breast is bilateral. It may be more



FIG. 9.—(Pathol. No. 32451.) The operator felt that the tumor was benign. In the gross it was a non-encapsulated cystic adenoma. He removed the tumor with a zone of breast. The pathologist diagnosed it adenocarcinoma. The complete operation followed in one month. The glands showed no metastasis. The patient is well eighteen years later. There has been normal lactation in the remaining breast. About this section pathologists will disagree, but in my experience, the patient will live.

advanced in one breast than in the other; for example, one breast may be simply shotty without a very definite edge and not yet saucer-like; while the other breast may have reached the saucer stage. The pathological process first appears in the upper and outer quadrant of both breasts. It always involves more than a quadrant and encroaches first more on the upper and inner quadrant than on the lower and outer. The lower and inner quadrant seems to be the last to become involved. Even over a fully developed zone there is no atrophy of the subcutaneous fat, or dimpling of the skin, except when there are signs of inflammation of the skin as already noted. As a rule the nipple is free, although there may be congenital contraction of one or both nipples or, rarely, intermittent retraction. Unilateral retraction of the cancer type has been present in less than 3 per cent. of the cases.

In my contributions in *Surgery, Gynecology and Obstetrics*, in 1906, I had only observed about four cases, and apparently I was interested chiefly in the pathology. I did not describe the clinical picture. In 1917, in a chapter on the breast, which I wrote for Binney's "Regional Surgery," although I know I was perfectly familiar, and had been for years, with this distinct shotty condition of the Schimmelbusch type of chronic cystic mastitis, I apparently did not describe it. But I did note (on page 606) that "We may palpate an indistinct tumor, a distinct circumscribed area, or a diffuse shot-like mass involving a quadrant, a hemisphere, or the entire breast." I have no record that in 1917 I as yet had become sufficiently impressed with

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the distinct edge and the saucer shape, although, I am confident, it was present when I palpated the breast shown in Fig. 3, in 1901, because this was the fully developed disease involving one quadrant, the upper and outer, of the larger breast, associated with a slight discharge from the nipple. The patient had been aware of this for four months, and she had had pain for six months.

Halsted described this sensation of fine shot-like masses in one of his earlier contributions, the reference to which I will add, if possible. I neglected to make reference to this in the monograph in the *Archives of Surgery* for 1921. In 1899, when I palpated this disease for the first time, I made the following note: "It involves a quadrant, and one could palpate an indurated area with many shot-like nodules and one larger cyst-like nodule." When I explored this area in 1899, thirty years ago, I found a blue-domed cyst with clear contents and a smooth wall, and when I divided the breast to remove this cyst, the surrounding breast had the appearance of a non-encapsulated cystic adenoma which I later saw in 1901 (Fig. 3). I had already seen one in an encapsulated cystic adenoma. We were not using frozen sections then, but I looked upon the lesion as benign and removed the breast. The patient was followed for ten years, and I reported this as the benign type of senile parenchymatous hypertrophy in 1907 in a chapter on the female breast in Kelly and Noble's "Gynecology and Abdominal Surgery."

It was in 1901, twenty-eight years ago, that all of us in Halsted's clinic had the opportunity to palpate and to study, in the gross tissue and in sections, the fully developed Schimmelbusch's disease as pictured in Fig. 3. The following is a quotation from our records: "On inspection, the outer hemisphere of the right breast was larger. On palpation, it was felt to be indurated like a 'caked' breast. The involved area had a distinct edge, and many shot-like nodules were felt. A brownish discharge could be expressed from the nipple." Therefore, between 1892 and 1901, we have a record of but three cases, while in 1923 we were able to palpate eighteen cases, and in 1928-1929 thirty cases.

In 1912 I recorded for the first time the lesion as bilateral and the intermittent retraction of both nipples.

The Clinical Picture of Other Groups of Chronic Cystic Mastitis.—When I completed the clinical and pathological study of 350 cases of chronic cystic mastitis and published them in the *Archives of Surgery* for 1921, I could divide them into eight pathological groups. As a rule the clinical picture was fairly distinct for each group, and as a rule there was not much overlapping. I have no explanation to make for the development of 174 single blue-domed cysts and twenty-eight multiple blue-domed cysts and eight white- or gray-domed cysts of the galactocoele type. These 210 cases presented a pretty definite clinical picture. In 182 patients there was a single palpable tumor in one breast. In the great majority the tumor felt like a globe, smooth and

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tense, was freely movable, gave the sensation of encapsulation, and often of fluctuation. As our experience grew, our sense of palpation more and more frequently recognized this single cystic tumor, and the diagnosis was confirmed by operation. In the eight years since this study we have only confirmed the clinical impressions recorded at that time. Now and then the cyst, when smaller than a ten-cent piece and buried in breast tissue, could not be recognized from other possible benign lesions, solid or cystic, or from the early stage of cancer. The benignancy of the single tumor was discovered only when the blue dome was exposed at the exploratory incision.

The remarkable feature of our records of these 182 cases of cysts is that in the early cases there is no note on the surrounding breast tissues or that in the other breast. Then we come to a period of careful palpation of both breasts, when we began to recognize the so-called "lumpy" breast with this single palpable tumor. Since 1921, our records show that in more than one-half of these cases both breasts are distinctly lumpy, and the single cyst is simply a larger cyst in a breast in which, when we divide the breast tissue to remove it, we find other minute blue-domed cysts, dilated ducts filled with all types of material, increased adenomatous areas, and every now and then a small, non-encapsulated zone, having the gross and microscopic appearance of non-encapsulated cystic adenoma, or Schimmelbusch's disease. That is, the common finding on palpation when one breast contains a blue-domed cyst or a cyst of the galactocele type is the typical lumpy breast. Rarely do we find, on palpation, a distinct single or multiple tumor in Schimmelbusch's disease, and with equal rarity is there an association between a palpable cyst in one or both breasts and the varicocele tumor of the breast due to the dilatation of the ducts beneath the nipple. There is no explanation for this, but the fact remains—and I called attention to this in December, 1906, twenty-three years ago in *Surgery, Gynecology and Obstetrics*—that we can divide chronic cystic mastitis into two great groups. In one, a large single or multiple cyst predominates in the gross appearance; in the other minute cysts or dilated ducts, or papillary-cystadenomatous areas. The proportion of the large cystic type to the non-cystic type is about as 210 is to 140.

In 1921 we had a record of twenty-eight multiple blue-domed cysts. The clinical picture was definite multiple tumors in one or both breasts. Since then this group has become very large, but operations are very rare, except the removal of one cyst to make the diagnosis positive.

This cystic disease of the breast was well known and described by Billroth and Velpeau, and later by Warren, of Boston. I am inclined to think that it is always bilateral, although the clinical picture and the follow-up have not the same proof as in the Schimmelbusch type or the dilated ducts beneath the nipple. But when the single cyst is removed from one breast and the patients are followed, there is more apt to be recurrence or the appearance of a second cyst in the opposite breast, and when we observe definite multiple cysts they are more common in one breast than in both breasts, and in our

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recent studies with our finer developed sense of palpation we generally make out and record that these single or multiple definite tumors appear in breasts that are distinctly lumpy. Nevertheless, even today, if one palpates a single definite tumor, it is not safe to make a diagnosis of chronic cystic mastitis and postpone operation, even if both breasts are lumpy or shotty, or there are distinct dilated ducts beneath the nipple. But when a woman has been operated upon and the tumor is a definite cyst in chronic cystic mastitis and a new tumor appears in the same or in the other breast, it seems perfectly safe to give it a chance to disappear.

In 1921, among the 350 cases of chronic cystic mastitis there are fifty-six, or about 20 per cent., in which there was not a single or multiple tumor like a cyst, nor a dilated duct beneath the nipple, nor the shotty breast of Reclus's disease. As a matter of fact, this is rather an indefinite group in which the complete operation for cancer or the removal of both breasts has been performed by inexperienced surgeons or on incorrect pathological diagnosis. The majority of these fifty-six cases were, clinically, lumpy breasts which we now recognize and do not subject to operation. In a few of these lumpy breasts, before the removal of the breast, or the operation for cancer, one palpable area had been excised and submitted for microscopic diagnosis, and the removal of the breast or the cancer operation had been performed because of a diagnosis of malignancy or suspected malignancy. Fewer and fewer of these cases, I am glad to record, are being subjected to operation in the clinic, or sent to the laboratory from outside sources. The lumpy breast is much more common than the shotty breast. In 1921 they were as fifty-six to thirteen; in 1929 the relative number of lumpy breast has increased. The greatest difficulty in this group is when one lump is a little more distinct than any other and perhaps has been localized by the patient herself, with and without the guiding sign of localized pain or tenderness. Such lumps should be explored, and often it is difficult, with the frozen section or any other kind of microscopic section, to distinguish a non-encapsulated area of senile breast or old fibro-adenoma, or chronic cystic mastitis, or chronic mastitis, or residual latent lactation mastitis, from early cancer. Frequently in these areas the basement membrane so characteristic of normal parenchyma is absent, and the epithelial cells rest upon the stroma leading to a suspicion of malignancy or a diagnosis of definite cancer.

The varicocele tumor of the breast, with the rarest exceptions, is situated beneath the nipple and usually is bilateral. One may feel beneath one or both nipples one or more little dilated ducts which usually have the shape of an angle worm. Now and then pressure produces discharge from the nipple. The clinical picture of a non-encapsulated cystic adenoma is not any different from that of any other single tumor of the breast. The remarkable feature about this is that in the cases I reported in 1921—about eighteen in number—the complete operation for cancer was performed in every instance, either from frozen sections at the time of the operation, or, after longer intervals

of days or weeks, during which time the permanent sections were repeatedly studied and often referred to one or more consulting pathologists.

Clinical Picture of Other Diffuse Lesions of the Breast Which May Be Confused with the Shotty Breast, or Diffuse Chronic Cystic Mastitis of the Papillary Cystadenomatous Type.—A quadrant, a hemisphere, or the entire portion of a breast may be indurated and produce an enlargement which palpates somewhat like the shotty breast. I have previously discussed this, especially in the *Boston Medical and Surgical Journal*, and always bear these possibilities in mind when I palpate a diffuse lesion of the breast which should be included in the term mastitis or "caked" breast. What may be the etiological factor of this diffuse mastitis?

(1) Trauma with resultant ecchymosis and hematoma, leading to traumatic mastitis; (2) the caked breast of pyogenic mastitis of pregnancy or lactation; (3) tubercular mastitis; (4) metastatic mastitis which rarely occurs, but is seen after any infection like typhoid fever, pneumonia, or any other local or general infection; (5) the diffuse comedo adenocarcinoma, and (6) diffuse carcinoma, as a rule of the clinically acute type, and morphologically the cells are grade 4, that is the most malignant cancer cell.

In the great majority of cases one can recognize the shotty breast of diffuse chronic cystic mastitis because it is bilateral, and because the palpation of numerous shot-like nodules rarely predominates in the picture of the other groups. The distinct edge may be present in the other groups, but the peculiar saucer shape assumed by the breast, when it is lifted off the chest wall by the edge, is never present in the other groups. The other forms of diffuse mastitis are as a rule unilateral. They are less apt to have a distinct edge and they are rarely shotty. However, I have seen every one of these seven groups of diffuse mastitis in which there was no change in the nipple, no dimpling or adherent skin, no atrophy of fat, no œdema of the areola—nothing on which to base the diagnosis except the palpation of an indurated mass occupying from a quadrant to the entire breast. In this small group the diagnosis can only be made from the frozen section at the exploratory incision. Up to the present time I have never explored a traumatic mastitis. The clinical picture immediately after the injury is so distinct. There is first, the definite, visible ecchymosis and the history of a recent injury. The palpable area of induration of the breast is, as a rule, larger than the ecchymosis. Not a single case showed a definite edge, or the saucer shape, or the fine shotty nodules. As the color of the ecchymosis faded and disappeared, the diffuse mastitis broke up into multiple nodules, first definite, then indefinite, until finally all disappeared. As a rule the duration of the residual palpable area was three months. On a few occasions tissue removed from such breasts has been sent to the laboratory for diagnosis. The characteristic microscopic finding was hæmorrhage. I have only observed this in multiple intracystic papillomas. When we find the histological picture of chronic cystic mastitis, there is no way to tell whether it was

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present before the injury or was the result of it. I have never observed a section of traumatic myositis to give the histological picture of mastitis.

The Caked Breast of Pyogenic Mastitis of Pregnancy and Lactation.—Kilgore, in a recent number of the *Archives of Surgery*, from a study of the cases and records in the Surgical Pathological Laboratory of the Johns Hopkins University and Hospital, emphasizes the previously unknown fact that cancer is relatively frequent in these conditions of the breast, provided the patient is of the cancer age, and we must bear in mind that late marriages place more mothers in the cancer age. If the caked breast is bilateral, it is against malignancy, but it does not rule out tuberculosis. This type of mastitis has never impressed me as suggesting the shotty breast. However, it is impossible, in the earliest stages, to distinguish the indurated area from cancer or tuberculosis. It has been my rule, in all cases of mastitis during pregnancy or lactation, to explore at once, unless the area subsides or forms an abscess. In the latter event there is no difficulty with diagnosis, and the abscess is treated as any other abscess and drained. As a matter of fact, I have rarely seen such a case, but many histories record the diagnosis of mastitis during pregnancy or lactation in which the clinician, either because cancer was not considered or because there was no definite symptoms, waited until cancer developed. But in the past five years we rarely had an example of mastitis in pregnancy or lactation, because these women are under the care of the nursing or medical profession, and the nipples are kept clean.

Our histories show that the incidence of mastitis in the lactating breast has dropped from more than 20 to less than 1 per cent. This should impress upon everyone that a woman who has a caked breast in pregnancy or lactation today, runs a greater probability of cancer than ever before, and there should be no delay in exploring a frozen section.

Tubercular Mastitis.—Remember, this may be bilateral. It is more frequent in pregnancy. It may involve half the breast before there is a sign of an abscess. It has no distinctive gross appearance before the stage of caseation. Microscopically, tuberculosis in lactation hypertrophy gives a picture closely resembling cancer. When you find a definite giant cell tubercle, you can rule out cancer, but when only lymphoid granulation tissue is seen mixed with lobules of lactating breast in which the basement membrane is destroyed by the inflammatory process and the morphology of the epithelial cell changed for the function of producing milk, the microscopic differentiation from cancer requires experience. In those years when tuberculosis of the breast came under observation with sinus or abscess, there was no difficulty in making a clinical diagnosis. Nevertheless, even in this group, I find a number of microscopic diagnoses of cancer; but today the patients with tubercular mastitis come under observation with an indurated mass in one or both breasts. When only one breast is involved, cancer must be ruled out. The presence of tuberculosis in an X-ray of the chest is evidence in favor of tuberculosis of the breast, but in the one case in which I was

influenced by such an X-ray picture to postpone operation, the lesion of the breast proved to be cancer.

Metastatic Mastitis.—I find I have notes on but a few cases. In none was there any difficulty in the diagnosis. The definite history of the previous infection which as a rule was grave, the fever and leucocytosis associated with the breast condition. In not all of the cases did the mastitis go on to suppuration.

Cancer Mastitis.—It is interesting to record that the least malignant type of cancer of the breast and the most malignant, may begin as a diffuse area of induration, palpating like a caked breast, with the rapid involvement of a quadrant or more. The lesion is unilateral. None of the cases palpated by me have been shotty, although there is a distinct edge. None had the saucer shape. But many of these cases have been diagnosed mastitis, although the patients have been neither pregnant nor nursing, nor has there been a history of a recent injury or infection. The diagnosis of a non-malignant mastitis, when the mass in the breast appears spontaneously without any history of the usual etiological factors, is a very dangerous one. In the past year three such cases have come under my observation in which such a diagnosis had been made, and all of them had been treated with the violet rays or sunlight.

I again urge my colleagues, who are interested in improving their expertness in palpating lesions of the breast, to go over carefully what records they have of these seven possible types which may produce an indurated mass in the breast, and I would sincerely appreciate notes on their cases, with the pathology and the results. In my experience chronic cystic mastitis of the diffuse adenocystic type is becoming more and more the predominant lesion, because more and more women are reporting at once for examination. The probabilities are that the incidence of cancer mastitis has always been small, and now, of course, is more so than ever. There is no doubt that tubercular mastitis is on the decline. Traumatic mastitis, from my records, is distinctly on the increase along with cystic mastitis.

Clinical Picture of Breast Lesions.—I have in mind the reproduction, if possible, of illustrations picturing the normal breast and the different types of chronic cystic mastitis in somewhat diagrammatic form in which the gross lesion is seen through transparent skin, but I have had no opportunity to have these illustrations made as yet. The only way, however, to get a real picture of the varying pathological lesions is to palpate the breast, to make a diagram and record of what is felt and then, if operation is done, associate the gross and microscopic findings with the clinical record. When the entire breast is removed, one can make a whole microscopic section as advocated and practiced by Cheatle, of London, and as is being so well done by Wainwright, of Scranton, Pa., in this country. But I am confident that every one who reads this will agree with me that the clinical picture of breast lesions is changing, perhaps not so rapidly as in my own clinic, but rapidly enough to make diagnosis more and more difficult. To repeat, in Halsted's clinic,

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up to 1900, more than 99 per cent. of the women who came into the clinic had definite lumps of the type that should be operated upon. In my own clinic since 1925, less than 35 per cent. have definite lumps in which operation is indicated, and the incidence of cancer in the operative group is fifty instead of eighty.

The more women are enlightened the greater will be the per cent. of the cases in which operation is not indicated. The group of chronic cystic mastitis which is a disease that has a tendency to disappear, is observed less and less frequently in women who delay examination, and most frequently in lesions of one month's duration.

I have told my students in the past five years that most of the written records collected in the laboratory, on the palpation of breast tumors, are of little value today, because they record the clinical picture of a neglected tumor. The difficulty today is, first, to find the lump; second, to really recognize the lumpy breast, the shotty breast, and the dilated ducts beneath the nipple. There is no doubt that women are feeling lumps, whether single or multiple, much earlier than ever before, because in my experience in the past two years, I had the opportunity to palpate more single indefinite lumps than ever before, and at exploration to find cancer in its earliest stage more and more frequently.

Frozen Sections.—I again call attention to the microscopic illustrations in the *Archives of Surgery* for 1921 and, to repeat, it is safer to do the complete operation if the pathologist is in doubt. Fortunately the number of women that will be mutilated will be relatively small. It is a dangerous procedure to explore a lump in the breast of any women over forty without preparing the patient for the complete operation and without being prepared to make an immediate frozen section.

Gross Pathological Diagnosis of Breast Lesions.—There are a few gross appearances remaining which are sufficiently distinct to allow one to be certain that the lesion is benign, even if the microscopic section is suspicious of malignancy. When the tumor proves to be a definite abscess, cancer can be ruled out, although the tubercular or non-tubercular mastitis may suggest malignancy in the frozen section. When one explores a definite tumor and finds a blue dome and, on nicking the dome, exposes clear or cloudy fluid, and on opening the cyst, the wall is smooth, there is no question as to the benign nature of the lesion. However, in the wall of this blue-domed cyst, or in the surrounding breast, there may be present adenocystic types of chronic cystic mastitis difficult to differentiate from cancer. When I find such a microscopic picture around a blue-domed cyst, I am always conservative, but now and then, when I find them, without a definite blue-domed cyst, I am apt to recommend the complete operation for cancer, because as yet the differential diagnosis between these atypical adenocystic changes in chronic cystic mastitis and cancer are so difficult to make that it is wiser, in the absence of a definite blue-domed cyst, to operate for cancer. We need a differential stain to make easier and more certain this differentiation. An

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encapsulated solid tumor of the breast is benign. Even when sarcoma develops in the intracanalicular myxoma, the definite capsule is lost. It is essential to learn to recognize encapsulation of breast tumors. Blood in a smooth-walled cyst, or in a cyst without a papilloma, means cancer. When the surgeon has a papillomatous cyst he should always bisect the base of the papilloma. If the papilloma has infiltrated through the cyst wall, it is malignant. Multiple cysts with papillomas are not necessarily malignant. Fully developed cancer in its earliest stages cannot be distinguished in the gross from a non-encapsulated adenoma or area of mastitis. We must no longer depend upon the gross appearance. We must depend upon frozen sections.

What Shall the Operator Do, When Pathologists and Frozen Sections Are Not Provided For in the Operating Room?—It is my opinion that this group of surgeons had better perform the complete operation for cancer when the palpable tumor is clinically malignant. They should only explore breast tumors when they are perfectly definite. They should excise the entire tumor with a zone of breast tissue, pack the wound with an alcohol sponge, put a towel on the left hand, place the tumor on the towel in the hollow of the hand, bisect the tumor. If it is a typical blue-domed cyst, or an abscess, or a distinctly encapsulated tumor, or a cyst with a papilloma, in which the papilloma has not infiltrated the wall of the cyst, remove no more than the tumor. In all other cases perform the complete operation for cancer.

When, however, the tumor is indefinite, I believe, it would be better for such a patient to be referred to a surgical clinic equipped for frozen section diagnosis in the operating room, because the probabilities are that these tumors are not malignant. If they are they belong to the most curable group. Gross diagnosis as a rule is impossible, and frozen section diagnosis difficult. Operation in stages for the malignant tumor is dangerous.

SUMMARY AND CONCLUSIONS ON THE SHOTTY BREAST

In 1906 and in 1921, and again in 1929, I am attempting to make definite the clinical and pathological picture of diffuse chronic cystic mastitis of the papillary cystadenomatous type commonly known in the older literature as Schimmelbusch's or Reclus's disease and formerly (1906) called by me senile atypical parenchymatous hypertrophy. I believe that I am conservative and safe in again emphasizing that this is not a precancerous lesion any more than the lactating breast. But it may present microscopic pictures difficult to differentiate from cancer, and now that more and more women are coming immediately after the first symptoms, more and more breasts, the seat of chronic cystic mastitis of this and other types are being sacrificed, I am confident that if surgeons and their pathologists will give more attention to the study of chronic cystic mastitis, less and less women will be mutilated in our endeavor to persuade, through education, more and more women to have their breasts examined the moment they feel a lump or pain, or any other symptom which calls their attention to the breast. In order to give all

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women who may have a cancerous lump in the breast at least 70 per cent. chances of a cure, we must bring them all under observation within a month. In probably 70 per cent. of these cases any operation can be decided against by palpation alone. Of the 30 per cent. in which the breast must be explored, in one-half or more the benignancy of the lesion can be recognized by a combination of gross inspection and immediate frozen section. Therefore, this surgical lesion is enough to justify a more comprehensive study of chronic cystic mastitis and the introduction of frozen sections in the operating room, and research for a differential stain.

THE SURGICAL TREATMENT OF DUODENAL ULCER

END-RESULTS OVER A TWENTY-FIVE YEAR PERIOD

By JOHN M. T. FINNEY, M.D. (By Invitation)

AND

EDWARD M. HANRAHAN, JR., M.D.

OF BALTIMORE, MD.

THE object of this paper is not to advocate any one surgical procedure as opposed to any other, nor is it to press the claims of surgical as against medical treatment of duodenal ulcer. It is rather an attempt, from a study of all the cases that have occurred in the surgical services of the Johns Hopkins and the Union Memorial hospitals during a twenty-five year period (1900-1925), to determine just what one is justified in promising a patient who consults him for duodenal ulcer, and also, which offers the better chance for relief or cure, medicine or surgery. Furthermore, for our own personal satisfaction, we have endeavored, by the same means, to secure information of value in helping us in the matter of the choice of operation, when it may be needed.

The true evaluation of any therapeutic procedure is possible only when compared with the natural history of the disease against which it is used. In order, therefore, to determine the therapeutic value of a surgical procedure, such as pyloroplasty or gastro-enterostomy in duodenal ulcer, we may well use two standards of comparison. The first is the result obtained following expectant or medical treatment alone, to be accepted, owing to obvious uncertainties, with some reservation; the second is the result following the use of other surgical procedures.

Inasmuch as the etiology and pathogenesis of duodenal ulcer are not yet clear, all forms of treatment, both medical and surgical, are based upon accumulated experience and, therefore, are largely empirical in character. Both medical and surgical procedures aim to relieve pain; to secure better drainage; to put the affected part at rest; to limit the amount of trauma by the passage of rough and irritating foods; to eliminate possible foci of infection elsewhere in the body.

The physician, as a rule, does not refer his patient to the surgeon as soon as the diagnosis of duodenal ulcer has been made, unless the diagnosis has been established by the occurrence of an acute complication, such as perforation, hæmorrhage, etc. The patient who comes to his physician because of periodic hunger pains, with their demoralizing effect upon his general morale, is of the class which chiefly interests us in this discussion. He does not present a surgical emergency. He is an individual who may or may not have a lesion of the duodenum which, if present and unoperated upon, may have to be nursed for a long time, possibly for the remainder of his life. The resulting disability may be slight, or it may be great, even

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to such an extent as to incapacitate him for his ordinary routine of living. Whether or not surgery offers this patient more than medical treatment is a question which interests doctor and patient alike, and whose answer we must find in the comparison of sufficiently large groups of cases which have been carefully studied and treated each way.

Unfortunately, for our purpose, many of the publications dealing with the medical treatment of ulcers make no differentiation between gastric and duodenal types. Most surgeons, however, feel that these two conditions present quite different problems and, therefore, should be dealt with differently.

Crohn states, "In general it may be safe to say that conservative medical treatment permanently cures 40 per cent. of its cases. During the course of treatment, 1 or 2 per cent. may die of hæmorrhage, and probably even a smaller percentage of perforation." In considering the general prognosis of gastroduodenal ulcer, he says: "Death from hæmorrhage, perforation or malignant degeneration occurs infrequently, and then usually within the first few months or years. If a case remains rebellious to medical treatment, and uncured after several years of symptoms, danger of death from the ulcer or its complications is remote. But, the chance of healing with permanent cure from medical treatment also becomes less favorable with the passing years." On the other hand, surgery, according to its advocates, will cure 90 per cent. of the operated cases which survive operation.

Crohn's studies of immediate and late results of medically treated duodenal ulceration agree in general with those reported by other observers. He finds that the immediate results are very good, namely, 86 per cent. are apparently cured, only 14 per cent. remaining unimproved. Most of the recurrences take place during the second six months, when 34 per cent. of the apparently cured cases develop unfavorable symptoms. With succeeding years, new cases of recurrence are added, but no longer at the same rate of progression. Within four years, 50 per cent. of the apparently cured cases will have relapsed. From this very general comparison, we must be impressed by the fact that, after deducting the operative mortality, the percentage of patients who are immediately benefited, following either medical or surgical treatment, is essentially the same, but, as the length of time following treatment increases, recurrences appear more frequently in the medically treated group.

The choice of treatment may well be based on the age, temperament and economic condition of the patient, and the duration and severity of the symptoms. The patient who is over forty, who has had symptoms either constantly or even recurrently over a period of years, who, because of temperament or lack of means, is unable to follow the necessary dietary regimen, is more properly a candidate for surgery than the young man who has very recently developed signs of duodenal ulcer and whose occupation, means and temperament permit him to pursue a properly regulated and supervised course of medical treatment. If, after a fair trial of medical treat-

ment, the disease has not been controlled, then surgery would seem to be indicated.

After consultation with our colleague, Dr. Thomas R. Brown, we have formulated the following as a list of valid indications for surgical intervention in duodenal ulcer, other things being equal. It would appear that this list of indications should satisfy both the physician and the surgeon.

Perforation; organic obstruction; impaired motility; repeated hæmorrhages; persistent pain or discomfort, due to local peritonitis, perigastric or periduodenal adhesions; unrelieved pyloric spasm; chronicity, repeated failure to bring about relief by medical and dietetic means, assuming, of course, that the treatment and after-treatment have been wisely advised and conscientiously carried out; economic factors, importance of limiting the period of disability in working people; the possibility of malignant degeneration of gastric ulcer, as suggested by a gradually falling acid, persistent occult blood, slight lessening of appetite, strength, blood count, etc.; the possibility that the ulcer may be secondary to, or its symptoms kept up by, disease of appendix or gall-bladder or both. This triad being relatively common, and, as a rule, unamenable to the usual treatment of gastric or duodenal ulcer by medical or dietetic means, is often brilliantly cured by the removal of diseased appendix or gall-bladder.

Having reached the decision to operate, what type of operation offers the best chance of relief? There have been many procedures advocated from time to time. These, in general, include pyloroplasty, or gastro-enterostomy, either alone or combined with excision of the ulcer, sympathectomy, and partial gastrectomy. Appendectomy or cholecystectomy are often combined with these. Excision of the ulcer alone may occasionally be employed. The benefit through pyloroplasty is believed to result largely from relief of obstruction and the abolition of pylorospasm, with the consequent reduction in the emptying time, together with the accompanying reduced gastric acidity. Gastro-enterostomy is also believed to reduce the pylorospasm. The amount of irritation from food is diminished by means of the short-circuiting and it is believed that reduction in gastric acidity may be favored through regurgitation of alkaline duodenal secretion and improved drainage.

Resection of large portions of the stomach wall has met with favor in many European and in a few American clinics. Its advocates believe that the resulting quantitative reduction in gastric acidity (which is due, not as originally stated, to the removal of the acid-bearing area, but to the removal of the stimulating factor, whatever that may be) diminishes the likelihood of subsequent gastrojejunal ulceration. Partial gastrectomy is a formidable procedure, even in the hands of the expert surgeon. Before we can accept it in place of pyloroplasty or gastro-enterostomy, we must be convinced that the state of health induced in the survivors is appreciably better than that following the simpler operations. Of this we are not as yet convinced, although it is true that in our small series of resections, the results have, so far, been excellent, but the number is far too small from which to draw conclusions. The simpler operations have yielded almost as good results. If the main reason, as stated by some, for partial gastrectomy is the endeavor to avoid subsequent gastrojejunal ulceration, one should be convinced that

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this complication occurs with such frequency as to constitute a grave objection to the operation of gastrojejunostomy, as ordinarily performed. This has not been the experience of American surgeons as a whole; 5 per cent. may be stated as a conservative estimate, although Lewisohn of New York believes that it may occur as frequently as in 33 per cent. of all cases. Finally, it must not be forgotten that recurrent ulceration may follow partial gastrectomy.

The operation commonly known as "The Finney Pyloroplasty," first reported to this Association twenty-seven years ago, was a natural development from the Jaboulay gastro-duodenostomy. By extensive division of the pyloric ring, an enlarged gastric outlet is formed, the ultimate diameter of which is limited only by the diameter of the duodenum. One great advantage of this reconstruction is the temporary abolition of the action of the pyloric sphincter. Frequently, there is to be observed an effect similar to that produced by dilatation of the anal sphincter for fissure in ano, namely, relief of the distressing spasm, which so often accompanies it. In so far as gastric peristalsis permits, the stomach and the first portion of the duodenum are, by this procedure, converted into a single organ whose outlet is the descending portion of the duodenum, and into which there is no obstruction to the regurgitation of the bile, pancreatic juice and duodenal secretion. In the course of this operation, it is quite possible to excise ulcers on either the anterior or posterior wall of the duodenum, without materially altering the customary incision.

By virtue of the fact that there is a potential space between the posterior surface of the duodenum and the posterior abdominal wall, to which it is loosely attached, the duodenum may, as a rule, be so freed that its mobility resembles that of the embryonic state. Then, and only then, may the anastomosis be made with entire absence of tension. As we have repeatedly pointed out, it is upon the thorough accomplishment of this mobilization that the success of pyloroplasty depends.

In 1927, we began a study of the late results following all operations which have been performed upon the stomach and duodenum in the Johns Hopkins and the Union Memorial hospitals, between the years 1900 and 1925. This study has been interesting in many ways. During that period, a great increase in all types of gastric surgery has occurred, but the most spectacular increase has been in the number of operations for duodenal ulcer. For example, between 1900 and 1915, 50 per cent. of all operations in our series were for gastric ulcer; 43 per cent. for gastric cancer; 7 per cent. for duodenal ulcer. Between 1920 and 1925, duodenal ulcer was the surgical diagnosis in 40 per cent.; gastric cancer in 37 per cent.; gastric ulcer in 22 per cent. We can offer no satisfactory explanation for this apparent increase in the incidence of duodenal ulcer. It is difficult, however, to believe that it is a real increase.

We believe that a period of at least two years should have elapsed before the late result of an operation for duodenal ulcer may be determined with any degree of assurance. Our study is based on the results noted in 380

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consecutive patients who had been operated upon for duodenal ulcer. One-third of these (33.3 per cent.) were between thirty and forty years of age at the time of operation; 70 per cent. were under fifty years of age.

Our histories indicate that there is a marked difference in the proportionate distribution of gastric and duodenal disease in blacks and whites.

TABLE I

Results as Found in 1927, Following Gastro-enterostomy and Pyloroplasty for Duodenal Ulcer, Operated upon in the Johns Hopkins Hospital and the Union Memorial Hospital, between 1900 and 1925

Operation	Number of cases	Deaths within six months after operation	Not traced	New total	Living improved	Living unimproved	Died, of causes related to original condition	Died, of causes not related to original condition	Patients improved by the operation	Patients not improved by the operation
Gastro-enterostomy	96	16 (16.6 per cent.)	15	65	54	4	2	5	59 (90.8 per cent.)	6 (9.2 per cent.)
Pyloroplasty ...	139	8 (5.8 per cent.)	25	106	91	11	0	4	95 (89.6 per cent.)	11 (10.4 per cent.)

This same difference has recently been observed by Sturtevant and Shapiro. For example, 96.3 per cent. of our duodenal ulcer patients were white, while for gastric cancer, this was decreased to 90.7 per cent. In our series, duodenal ulcer has occurred much more frequently in males than in females, 86.3 per cent. as opposed to 13.7 per cent.

The operation most frequently employed was pyloroplasty. It has been the operation of choice, when conditions have permitted its performance, for the simple reason that we believe that it least disturbs the normal physiological relations, while affording relief to the distressing symptoms. This operation was performed upon 139 patients, fifty-two of whom were complicated by an additional operation, such as appendectomy or cholecystectomy. It should be stated that we make in every case a systematic survey of the abdomen and, at the same time, remove palpably diseased appendices or gall-bladders.

Gastro-enterostomy was done in ninety-six patients, in thirty-nine of whom an additional operation was performed. Therefore, in about 60 per cent. of our series, conditions were found suitable for pyloroplasty. This may be taken as a fairly accurate index as to the proportion of cases in which this operation is deemed advisable.

Of ninety-six patients in whom gastro-enterostomy was performed, sixteen, or 16.6 per cent., died within six months of the operation. This seems an extraordinarily high mortality rate, but it may possibly be explained by the fact that we have included the first six months, rather than a short

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hospital stay as the operative interval. We have done this because mere recovery from the operation by no means necessarily constitutes a cure. Sufficient time must elapse before the result can be satisfactorily determined.

Of 139 patients in whom pyloroplasty was performed, eight, or 5.8 per cent., died during the first six months. The result in our series, then, would appear to indicate that the mortality during the first six months after opera-

TABLE II
Causes of Death within Six Months After Operation

Operation	Operative shock	Cardiac failure	Pulmonary complications	Obstruction	Embolus	Unexplained or unknown	Total
Gastro-enterostomy .	2	1	1	11	1	0	16
Pyloroplasty.....	0	1	3	2	0	2	8

tion is nearly three times greater after gastro-enterostomy than after pyloroplasty. There were no immediate deaths following partial gastrectomy for duodenal ulcer in fifteen patients.

In all groups of our series large enough for statistical purposes, 15 to 20 per cent. were unable to be traced following discharge from the hospital. Of sixty-four patients who survived the operative interval of six months, after gastro-enterostomy, fifty-four, or 84.3 per cent., were living and improved upward of two years after operation. This percentage very closely approximates that following pyloroplasty, 85.8 per cent. Four, or 6.2 per cent., were living, but unimproved following simple gastro-enterostomy, while eleven, or 10.3 per cent., were unimproved following pyloroplasty. But while 9.5 per cent. of gastro-enterostomy cases died subsequent to the six months' period, only 3.7 per cent. died subsequent to this period after pyloroplasty. Eleven of twelve patients traced following resection were living and improved. One was living but unimproved, while none had died.

Our figures, therefore, as do the figures of most observers, indicate that about 90 per cent. of those who survive the usual surgical procedures are markedly benefited. But, in all fairness, we must remember that this high figure is reached only after an operative or immediate mortality of about 10 per cent. for the entire surgical group. Again, if we start with two hundred patients and treat one hundred medically and one hundred surgically, the experience represented by our figures would indicate that after a sufficient interval (ten years) sixty-three of the latter would be living improved; five would be living unimproved; fourteen would have died, ten soon after operation and four some time subsequent to it; and seventeen will not be located. With fairly diligently pursued medical treatment, the one hundred cases not operated upon will doubtless show comparable results. There will be a higher percentage who are living unimproved, but we would not have had an operative mortality of 10 per cent. These figures seem to indicate that a patient with symptoms suggesting a duodenal ulcer, but who does not

at the time suffer seriously from any of its complications, is not necessarily a candidate for immediate surgical treatment. If he lives in a community where reasonably good surgical attention may be secured, should he be advised to postpone operation until some complication intervenes, or until further pursuance of medical measures seems fruitless, or should he not? There would seem to be less chance of his developing a dangerous hæmorrhage or an acute perforation and dying from it, or from the emergency operation then demanded, than from the ordinary risk of operation under average conditions. We do not mean to imply that there is such a risk in the hands of a Mayo or a Moynihan, but we can do no more than point to the figures as given in our series, which is made up of the results of men who are, with few exceptions, in no sense to be considered as specialists in gastric surgery, but rather represent a cross section of surgical practice in general. It is from the standpoint of the average surgeon that we are speaking, and not that of the expert in gastric surgery.

As regards the type of operation, pyloroplasty has proved in this series to be a safer procedure than gastro-enterostomy. If in one hundred surgically treated patients, pyloroplasty has been performed, only eight would have died at the time of the follow-up; five immediately after operation; three subsequent to it. This is a more favorable showing than that of the combined surgical group.

Of the 380 cases of duodenal ulcer, thirty-one, or 8.2 per cent. had perforated. Of these, 16 per cent. died in the hospital; nine, 29 per cent., were not traced; fourteen, 45 per cent., were living and improved; one was living unimproved; two subsequently died. Our group of perforations is too small from which to draw more than inferential conclusions regarding the choice of operation.

We would emphasize the fact that the choice between medical and surgical treatment for uncomplicated duodenal ulcer will depend very largely on the mental, economic and social status of the patient. Unless unusual circumstances affect the decision, surgery should be postponed until time has shown that medical treatment is of little avail. Our study of 380 cases of duodenal ulcer treated surgically between 1900 and 1925 has shown that, while both gastro-enterostomy and pyloroplasty yield almost identical results in percentage of improvement among those who have survived the operation, the mortality, both immediate and subsequent, is lower after pyloroplasty, about three to one. Ninety per cent. of these patients who survived operation, and were traced, were well or improved for periods of from two to twenty years.

In this study no account, of course, has been taken of the imponderable factors of physical and mental distress; loss of time from work, due to rest treatment, starvation and other medical measures which interfere with the patient's activities, his ability to make a living or his enjoyment of life. It will be generally admitted, I think, that these factors loom larger under medical than under surgical treatment. The loss of time and money result-

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TABLE III
Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
1	F	48	Dec. 9, 1912	Emergency operation for hemorrhage and perforation	Peritonitis; perforation between gall-bladder (containing stones) and duodenum	Posterior gastro-enterostomy	Died shortly after operation. Autopsy showed large gall-stone in lower ileum, beyond which was contracted gut
2	M	62	Feb. 1, 1918	Ulcer history of long duration. Chronic moderate pyloric obstruction	Puckered scarred area around pylorus and duodenum. Adjacent lymph glands enlarged	Posterior gastro-enterostomy	Died day after operation
3	M	67	Dec. 24, 1917	Ulcer history of long duration. No severe complications	Ulcer on anterior wall of duodenum. Impossible to mobilize duodenum	Posterior gastro-enterostomy	Died two days after operation. Cardiac death
4	M	55	Mar. 26, 1914	Abdominal symptoms for five years. Cholecystostomy six months before operation	Dense adhesions. Scar in duodenum just beyond pylorus	Posterior gastro-enterostomy	Died suddenly seven days after operation. Suggested embolus
5	M	36	Nov. 6, 1919	Active ulcer history for six years. No complications	Old ulcer low down on duodenum. Many dense adhesions between intestines, gall-bladder, duodenum and transverse colon	Posterior gastro-enterostomy	Obstructive symptoms on third day. Wound infection. Enterostomy on fifth day. Died fifth day
6	M	54	Sept. 25, 1925	Symptoms one year. Increasingly active. Hemorrhage. Pain	Ulcer at pylorus, adherent. Recent inflammatory reaction	Posterior gastro-enterostomy	Obstruction seventh day. Explored. Edema of jejunum and its mesentery about stoma. Anterior gastro-enterostomy performed. Died that day
7	M	58	Oct. 19, 1907	Symptoms for three years. Loss of seventy pounds weight. Frequent vomiting	Extremely stenosed pylorus with surrounding adhesions. Dilated stomach	Posterior gastro-enterostomy	Obstruction—gastric tetany. Gastro-enterostomy on eleventh day followed by death. Autopsy. Both openings patent. Explanation of obstruction not clear

TABLE III—(Continued)
Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
8	M	49	Dec. 18, 1922	Gastro-intestinal symptoms leading to exploratory laparotomy September, 1921. Release of adhesions	Large indurated ulcer in duodenum. Adhesions precluded any mobilization	Posterior gastro-enterostomy	Bronchopneumonia. Died on fourteenth day
9	M	57	Apr. 29, 1922	Long ulcer history, bleeding during previous year	Puckering and scarring on inner border of duodenum. Adherent to pancreas	Posterior gastro-enterostomy	Obstruction. Explored on fifteenth day. Release of adhesions. Died fifteenth day
10	M	58	Nov. 27, 1914	Symptoms three years. Obstructive symptoms six months. Previous operation 1903—"Duodenoplasty"	Mass in duodenum. Dense adhesions	Posterior gastro-enterostomy	Obstruction. Explored fifteenth day. Great induration around anastomosis. Died nineteenth day
11	M	32	Feb. 13, 1917	Intermittent history over nine years. Anemic and undernourished	Duodenal ulcer—2 cm. Many adhesions. Pylorus, duodenum, gall-bladder and transverse colon	Posterior gastro-enterostomy. Appendectomy	Obstruction. Explored nineteenth day. Stoma patent. Upper intestine collapsed. Anterior gastro-enterostomy done below constricted small intestine. Died twenty-first day
12	M	50	Oct. 25, 1915	Several hemorrhages over four years. Recent pain	Indurated duodenal scarring with adhesions to colon and omentum	Posterior gastro-enterostomy	Obstruction. On twenty-second day. Explored. Kink in jejunum below stoma freed. Jejunostomy. Closure of pylorus
13	M	58	Dec. 23, 1924	Intermittent abdominal pain for years	Duodenal ulcer. Anterior surface	Posterior gastro-enterostomy. Resection duodenal ulcer	Obstruction. Release of adhesions sixteenth day. Gastrostomy and drainage, localized peritonitis twenty-first day. Died twenty-sixth day

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TABLE III—(Continued)
Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
14	M	51	May 2, 1913	Several years' history—Past six months hematemesis. Loss weight. Moderate anaemia	Small mass in duodenum. Thick adhesions binding duodenum posteriorly, and to the gall-bladder	Posterior gastro-enterostomy	Obstruction. Tenth to thirteenth days. Explored. Pylorus ligated. Died thirty-fifth day
15	M	34	Mar. 27, 1916	Three years. Recent obstruction. Poorly nourished. Moderately anaemic	Fairly large mass on duodenal side of pylorus. Duodenum adhered to pancreas and to gall-bladder	Posterior gastro-enterostomy	After three months developed signs of partial obstruction. At operation, the duodenal mass was diminished in size, so that partial gastrectomy was done. On fourth day following this operation, localized peritonitis was drained. Died that day. Survived original operation three months
16	M	43	Jan. 7, 1925	Five years. Several severe haemorrhages. Moderately anaemic	Ulcer on anterior surface of duodenum. Duodenum posterior and could not be mobilized	Posterior gastro-enterostomy	Obstruction after seven days. Operated upon fourteenth day. Jejunostomy. Died eighteenth day. (Edema of lungs

ing from long continued medical treatment will probably balance the expense of a surgical operation. But, on the other hand, one must not lose sight of the mental distress, the post-operative pain and discomfort and the inevitable mortality rate attendant upon surgical operations. No careful surgeon will, for a moment, lose sight of these possibilities.

Hence, in the final analysis, what are to be the determining factors in deciding between medical and surgical treatment, or between one operative procedure and another? The conscientious physician and surgeon will carefully weigh all factors in the light of accumulated experience and attendant circumstances, and decide accordingly. He will not be unduly influenced by custom or rule of thumb, or even weight of authority. He will decide each individual case on its merits, not by generalization or by standardization. Every case presents a separate individual problem, the satisfactory solution of which depends upon the exercise of surgical judgment of a high order in selecting the operative procedure best adapted to the individual case, which ability, in turn can only be acquired by giving due heed to the lessons that are to be learned from the open-minded study of one's end results.

In comparing the medical and surgical treatment of duodenal ulcer, it must be borne in mind that, as a matter of fact, the two are hardly comparable at all, since surgery usually begins after medicine has failed. The favorable cases will respond to medical measures, while surgery, as a rule, deals with those cases in which medicine has proved unavailing.

Again, in this series, pyloroplasty, as the operation of choice, was done in the easier and more favorable cases while gastro-enterostomy was reserved for those cases in which, for some reason, pyloroplasty was not thought advisable—perhaps the more difficult cases. These two factors may help to explain the favorable results under medical treatment, and the rather high mortality rate after gastro-enterostomy in our particular series. In all fairness therefore, in attempting to compute relative mortality rates for different methods of treatment of duodenal ulcer, due allowance should be made for these and similar variable factors.

To Summarize.—We believe that a study of this series of cases of duodenal ulcer, representing, as it does, a cross section of the surgery done by the average surgeon, will warrant the following conclusions: (1) The immediate results obtained by either medical or surgical treatment are essentially the same; (2) the late results favor surgical treatment, inasmuch as 90 per cent. of those patients who survived the first six months following either gastro-enterostomy or pyloroplasty were improved or cured by the operation; (3) pyloroplasty, in properly selected cases, is the operation of choice, by reason of the lower mortality within the first six months after operation.

REFERENCES

- Crohn, B. B.: *Affections of the Stomach*. W. B. Saunders Co., Phila., 1927.
 Lewisohn, R.: *The Frequency of Gastrojejunal Ulcers*. Surg., Gyn. and Obst., vol. xi, p. 70, 1925.
 Sturtevant, M., and Shapiro, L. L.: *Gastric and Duodenal Ulcer*. Archives Int. Med., vol. xxxviii, p. 41, 1926.

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TABLE IV
Summary of Deaths Which Occurred After Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
17	M	42	June 1, 1916	Emergency — acute obstruction	Large hard indurated mass in duodenum apparently around an old ulcer	Posterior gastro-enterostomy	Died shortly after operation, on Feb. 7, 1919, for sarcoma of psoas muscle. Two years, seven months after gastro-enterostomy
18	M	43	Mar. 27, 1922	Previous operation one year before. Ventral hernia. Pain chief symptom	Large egg-sized mass in posterior duodenal wall	Posterior gastro-enterostomy. Repair ventral hernia	Died four and one-half years later, following operation for marginal ulcer
19	M	42	Nov. 26, 1913	Symptoms three years, intermittent severity	Thickened indurated duodenal scar adherent to gall-bladder	Posterior gastro-enterostomy	Died after four years—probably angina
20	M	55	Apr. 4, 1912	Symptoms fifteen years. Obstruction. Several hemorrhages	Duodenal ulcer adherent to stomach and gall-bladder	Posterior gastro-enterostomy	Obstruction on sixth day. Explored. Kink straightened. Good recovery. Died after six years, nine months
21	M	37	Aug. 24, 1917	Two years. Obstruction. Pain	Scarring both in anterior and in posterior duodenal wall	Posterior gastro-enterostomy. Appendectomy	Died—eight years, four months. Suicide. Had complete relief
22	M	49	Sept. 1, 1906	Six months, nausea and obstruction	Indurated area in duodenum—anterior and superior	Posterior gastro-enterostomy	Died after seventeen years of carcinoma of sigmoid. Good health up to this period
23	M	40	Sept. 25, 1912	Fourteen years. Hamatemesis, pain	Indurated duodenal ulcer adherent to liver	Posterior gastro-enterostomy	Reported dead. Time and cause unknown

TABLE V
Summary of Deaths Which Occurred within Six Months following Pyloroplasty

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
24	M	61	Jan. 4, 1923	Well nourished. Ten year ulcer history; pain and hematemesis	Ulcer scar about two one-half cm. below pylorus	Pyloroplasty Appendectomy	Died—twenty-four hours—following persistent vomiting. Thought related to myocardial failure
25	M	55	Mar. 10, 1920	Well nourished. Pain for six years	Pyloroduodenal ulcer adherent to gall-bladder	Pyloroplasty—Excision of duodenal ulcer	Died—nine days—streptococcus pleurisy
26	M	48	Feb. 25, 1924	Good condition. Symptoms for fifteen years	Ulcer scar on anterior pylorus—duodenum	Pyloroplasty—Excision of pyloroduodenal ulcer	Died—eight days—obstruction—with pneumothorax and lobular pneumonia
27	M	32	June 13, 1913	Very anaemic. Repeated hemorrhages, with four-year history	Thick adhesions between ulcer on anterior duodenum and gall-bladder	Pyloroplasty—Excision of duodenal ulcer	Died—five weeks—following drainage of empyema
28	F	35	Dec. 8, 1916	Perforated ulcer after four-year history	Perforation—1 cm. anterior duodenum. Partial closure by omentum; free peritoneal fluid	Pyloroplasty—Excision perforated duodenal ulcer	Died—six weeks—cause not given
29	M	46	Sept. 19, 1921	Ulcer pains intermittent for fifteen years	Old duodenal ulcer with adhesions. Chronic appendix	Pyloroplasty Appendectomy	Died—5 months—following operations for release of intestinal adhesions
30	F	54	Mar. 30, 1915	Nine-year history—pain—poorly nourished	Duodenal ulcer	Pyloroplasty Cholecystectomy	Died—within six months—"nephritis"
31	M	44	Sept. 27, 1915	Undernourished. Ten-year history	Adhesions between duodenal ulcer and gall-bladder. Chronic appendix	Pyloroplasty Appendectomy	Mental derangement two months. Retention. Died three months, following posterior gastro-enterostomy. Pylorus was patent

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TABLE VI
Summary of Deaths Which Occurred After Six Months following Pyloroplasty

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
32	M	55	Sept. 26, 1921	Symptoms — four years. Good condition	Cicatrizied duodenal ulcer. Chronic cholecystitis without stones. Chronic appendicitis	Pyloroplasty with excision of cicatrix. Cholecystectomy. Appendectomy	Died—(cardiac death)—after four years. Excellent health after operation
33	M	30	Feb. 11, 1916	Emergency operation for perforation — after three years of symptoms	Acute perforation of duodenal ulceration	Pyloroplasty with excision of ulcer	Died—suicide—after eight years. Greatly improved after operation
34	M	44	Feb. 2, 1917	Symptoms for seven years. Pain	Cicatrizied duodenal ulcer. Adhesions to chronically inflamed gall-bladder	Pyloroplasty with excision duodenal ulcer. Appendectomy	Died — "apoplexy" — after ten years. Had been in "perfect health"
35	M	40	Apr. 4, 1913	Intermittent pain and nausea for years	Cicatrizied pyloroduodenal ulcer, anterior	Pyloroplasty	Died—after twelve years—Operative result good. Several months of ill health. "Overwork" before death

These tables require little comment, as they speak for themselves. The mortality rate is increased by the fact that all deaths within six months after operation, from whatever cause, are included. If these were not included, the elimination of cases 27, 28, 29, 30 and 31 would allow us to quote a "hospital mortality" of only 3, or 2.2 per cent., following pyloroplasty. It will be observed also that the most common cause of early death following gastro-enterostomy was some form of obstruction. These cases, however, go back as far as 1900, when the "vicious circle" and other forms of obstruction were relatively more common than now, when, owing to improvements in operative technique, such complications are of infrequent occurrence.

THE RELATION OF BIOCHEMISTRY TO CANCER

BY WILLIAM J. MAYO, M.D.

OF ROCHESTER, MINN.

IN THE study of the human body the terms anatomy and physiology for many years were supposed to refer only to those tissues and functions that could be observed with the eye, or the eye aided by the microscope, and the most minute particles visible with the microscope were about $1/10$ micron or $1/250,000$ inch in diameter. When the study of matter was extended to include smaller particles, anatomy became physics, and physiology, chemistry. Yet the most minute fragments of matter of which we have any knowledge are physical, and chemical changes, processes in a general way known as biochemical, take place only in these minute subdivisions of matter.

The extraordinary revelations of modern physics, ushered in by an understanding of those waves which are known as light, which travel approximately 186,000 miles a second, have introduced us into a new realm of thought. The conception of matter today is that two particles or waves are concerned, the electron, representing an extraordinarily active negative phase of electricity, and the proton, positive and more massive, and that all matter is formed by varying degrees of fusion of electrons and protons in the form of atoms, which again are combined as molecules. Since the molecules are smaller than a ray of visible light, they do not diffract the light, but possess the characteristics of the mass. Colloids which are aggregations of molecules, and therefore larger in size, reflect rays of light. Colloidal particles include those from $1/1000$ micron or $1/25,000,000$ inch in diameter to those of $1/10$ micron or $1/250,000$ inch in diameter (visible to the eye aided by the microscope). Colloids, like molecules and atoms, are detectable only by ultramicroscopic methods.

A newer electric component is now comprehended as our understanding has enlarged, known as the photon, equally important with the electron and the proton. Electrons and protons are essentially indestructible. The photon has no such indestructibility. It represents the forces that are given off, under certain conditions, by atoms, consisting of masses of energy, with the same rapidity of wave motion and other characteristics of the electron and the proton, but it is destructible in the sense that the energy contained is completely dispersed as another force may be exhausted, or as it may be combined with atoms.

The light which makes plants grow and which gives us warmth has the double characteristics of waves and particles, and is found to consist ultimately of photons. The photon, then, has to do undoubtedly with our whole understanding of ultraviolet rays, some of the vitamins, and many of the

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newer conceptions which concern the chemical exchanges of the body. As far as life is concerned, the photon is as important as the two better understood and longer known particles which we speak of as the electron and the proton.

The subject of light and its influence on the human body, and the potentialities of various kinds of food substances which in one way or another are derived from light and act as light carriers, opens up an entirely new aspect of metabolism as related to health and disease. In all of the known combinations of electron, proton and photon in our conception of physics, the elements still maintain a place, although a precarious one.

Investigations of the elements by Moseley, the brilliant young scientist, who at the age of twenty-eight was killed in the Gallipoli campaign, have brought out some interesting facts from which certain deductions can be made that apply to medicine.

We know that there are ninety-two elements varying in atomic weight from hydrogen, which is the lightest, to uranium, which is the heaviest, and that between each two elements in the progression of atomic weight there is approximately the weight of an atom of the element hydrogen. It is possible, although not yet shown, that elements which are close in the scale of atomic weight can be changed, experimentally, at least, into the element above or below. Miethe and others have attempted to convert mercury (200) into gold (196) thus carrying out the dream of the alchemist.

It is scarcely necessary to call attention to the enormous value of such investigations as related to the industries. The molecule of coal contains fewer atoms of hydrogen than the molecule of petroleum oil. Bergius has been able to force additional atoms of hydrogen into certain types of coal and thus has produced petroleum oil. With the extraordinary accomplishments of physics and chemistry as related to the industries, the production of artificial rubber, artificial silk, and artificial foods, many profitable researches in human metabolism are being initiated, either in the discovery of the causative agents of disease or those factors which have to do with the development of resistance to disease.

As illustrating the newer conceptions of the elements no better example can be taken than chlorophyl, the green coloring matter of plants, which is one of the most important substances in the world. Chlorophyl is able to convert the heat and energy of the sun's rays into power for transforming water and carbon dioxide in the atmosphere and certain inorganic materials from the earth into carbonaceous compounds. For this purpose, the element magnesium is essential, just as in the subsequent conversion of this material into heat and energy in the human body, the element iron is necessary.

Life is maintained in the cells by combustion, an exchange of electrons which is carried out in the colloids of the cells. In the bodily economy, the element oxygen, which composes from 18.5 to 20 per cent. of the blood, by volume, is associated with iron, of which there are one or more atoms in every molecule of hæmoglobin.

In animals below the vertebrates, such as the *Amphioxus*, which in the scale of life stands between the vertebrates and the invertebrates, there is only white circulating fluid, and in this fluid the element copper takes the place of iron.

In the vertebrates copper has a powerful influence on respiration. This curious relation of copper to vital processes is seen in the treatment of pernicious anæmia by the administration of liver. The extract of liver tissue appears to have the same effect as liver itself, and experimentally, in conditions of anæmia, the ash has the same effect; the essential elemental constituent is copper.

The liver is the great detoxicating agent of the body, and to a large extent the source of the plasma of the blood. If a measured piece of the spleen or other organ is placed in the abdominal cavity of an animal, harm may not result, but if a similar piece of liver is thus placed, the animal dies, and its liver shows the greatest effect from the resultant toxæmia.

Krogh has shown that the walls of the vascular capillaries contain contractile cells, derived from the non-striated muscle, which are to a large extent self-controlled. Under the circulatory pressure of the systole of the heart, the capillaries permit oxygen and molecular substances, such as the crystalloids and amino acids, to pass by filtration, osmosis, diffusion, and other forces, through the stomas in the vessel wall to serve vital purposes, to maintain nutrition, and produce heat, and energy. The ash of this combustion passes into the venous capillaries to be carried to the emunctories, and the blood passes to the lungs for a fresh supply of oxygen. When, however, certain toxic poisons, for example, histamin, paralyze the contractile cells, causing the stomas in the capillary walls to open more widely, larger bodies, possibly colloids just above molecular size, and fluids of the blood plasma, pass from the capillaries into the tissues, resulting in the condition known as shock.

Carbohydrates (glucose, $C_6H_{12}O_6$) and fats (stearic acid, $C_{18}H_{36}O_2$) have no powers of building the body. The carbohydrates furnish heat, from which we recognize only the carbon dioxide as it is exhaled from the lungs, because by oxidation, hydrogen, which is a source of great value for heat and energy, is converted into water, which is used in the system. The fats are oxidized slowly because of the small amount of oxygen they contain, but they produce a much larger amount of heat and a greater quantity of water than the carbohydrates. The utilization of water produced from oxidation of fats and carbohydrates is shown in the hibernating animal, whose temperature during the winter drops to about 50° , approximately that of the cave in which the animal takes his winter sleep. In the great retardation of all bodily functions and complete cessation of the function of the kidney, the physical needs are supplied by the slow oxidation of the stored autumnal fat which gives not only the little energy necessary to carry on life, but also the essential water.

Roger, a French experimenter, found evidence which led him to believe

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that metabolism of much of the fat is accomplished in the lungs, where oxygen is plentiful. The fat is carried from the intestinal tract through the thoracic duct to the left subclavian vein and finally deposited in the arterial capillaries of the lung, into which it finally disappears. He demonstrated that the blood from the right side of the heart contains a much larger amount of fat derivatives than the left. The experiment seems to show that oxygen is necessary for the conversion of fat, and that the conversion of fat into a form suitable for bodily use is not primarily a function of the liver.

Protein, on the contrary, contains in addition to the elements carbon, hydrogen, and oxygen, the element nitrogen and a little of the element sulphur. The nitrogen we know is necessary to the building of tissue, forming compounds in which may be deposited calcium and other elements. Seventy-nine per cent. of the atmosphere is nitrogen.

The oxidation of carbon and hydrogen within the body which gives rise to heat and energy is the outstanding feature of all animal life, but while the normal cell functions within normal limits, the carcinomatous cell oxidizes without control and without function. The analogy between the rapid growth of the fertilized ovum and growth of cancer has often been pointed out. The growth of the one, however, is orderly and with purpose, of the other disorderly and without purpose.

There are two theories of biological oxidation, the oxygen activation theory of Warburg, and the activation-of-hydrogen theory of Wieland. Hopkins gives the weight of his authority to Wieland's theory as best explaining the chemistry of biologic processes.

Since uncontrolled combustion of food material is the most important feature of the growth of cancer, it is worth while to consider how combustion normally is controlled.

If a pound of glucose is burned outside the body it will produce the same amount of heat and energy as if burned in the body, but in the air it will burn only at temperatures over 400° C. What holds the temperature of the body at 98.5° F.? The best explanation at present is that oxidation is carried on by catalysts or enzyme action. Kendall and others have shown that one of the agents which influences oxidation, glutathione, contains one atom of the element sulphur to the molecule and that if this atom of sulphur is removed, it ceases to function in this way. Sulphur itself has no such effect on metabolic processes. When a growth begins to undergo hyaline degeneration, there is a definite slowing up of the malignant process. In this connection, it is known that hyaline and keratin contain a high percentage of sulphur. This indicates two different effects of sulphur depending on its form of combination.

In studying the manner of oxidation in the body, it is apparent that the size of the nucleus of the cell determines the rapidity of the process. Biochemically, the nucleus appears to be the agent of oxidation which enables the cell to secure nourishment. The most rapidly growing embryonic cells of the body are those derived from the chorionic villi (Langhans's

cells). Langhans's cells have extremely large nuclei and undergo the most rapid division of any normal cells in the body, but there is no peculiarity in the structure of the nucleolus and the cytoplasm of the cells. Wilson, MacCarty, and Broders have shown that the malignant cell has not only a large nucleus, but, also noteworthy, a large nucleolus. Broders's classification of the malignancy of tumors has been based on a comparison of the malignant cell with the normal cell of the same tissue. In brief, it has been found that when malignant cells are compared with the rapidly growing normal cells, the nucleolus as well as the nucleus is found to be greatly enlarged. It would appear that the size of the nucleus controls the total activity of the cell in relation to its increased blood supply, whereas the nucleolus may control the function of the cell in relation to the necessities of life. The increase in the size of the nucleolus, as well as the nucleus, means not only rapid and uncontrolled production of cells but cells without function, which is characteristic of cancer. In other words, the greater the variation of the malignant cell over the normal cell the more malignant the growth.

The excess of nucleus in the malignant cell over and above the normal cell is evidently due to an excess of the normal activating enzyme or oxidizing agent which controls combustion. Heat and radio-active substances and some elements reduce or destroy the oxidizing power of the nucleus and the nucleolus, particularly of malignant cells which are less resistant than normal cells.

Bell, of the University of Liverpool, in his work with the use of the element lead in cancer, has obtained some very interesting results, although the practical application of lead in the treatment of cancer has not proved very successful and not free from danger. His attention was called to the possible value of lead by observing its effect on workers in lead at Liverpool. Persons who had advanced cancer and yet were forced by the exigencies of life to earn, and who had taken up employment in the lead works, often experienced a decided change for the better: pain disappeared, the growth became very greatly reduced, due to the effect of lead on oxidation of the rapidly growing cell, and the malignant processes occasionally were held in abeyance for a considerable length of time. Bell is particularly interested in gynecology, and he learned that lead frequently caused sterility, usually temporary, in both men and women who worked in the lead works. This fact led him to investigate not only the effect of lead in cancer, but also its destructive effect on the rapid growth of the syncytial cells of the chorionic villi (Langhans's cells). He was able to show marvelous resemblances between these controlled but most active embryonic chorionic cells and malignant disease.

The element gold in colloidal form has been shown to have, to some extent, such an effect. Arsenic, another element, at various times has had a reputation as a cancer cure, both as an external application, an escharotic, and given internally. At times it has enjoyed a reputation as a palliative,

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probably through its effect on the bodily tissues encouraging resistance of the normal tissue and acting deleteriously on the lowered vitality of the cancer cell. Those who go back a quarter of a century and remember the work of Alexander, of Massachusetts, in the treatment of cancer with arsenic, cannot get away from the conviction that it had some effect, but it did not cure. While it is quite true that neither lead nor arsenic has achieved a solid reputation as a curative agent, they at least direct our attention to susceptibility of the cancer cell to certain chemical agents.

Fischera, of the University of Rome, in the study of certain types of tumors associated with pregnancy, noticed the regression of tumors due to the absorption of substances derived from embryonic tissue. Acting on the known facts, first that all living animal tissue, as the result of its energy, produces metabolic substances which are poisonous to living tissue of the same kind, and, second, that the more immature the cells of the body, the more effective these poisons, Fischera manufactured serum from human embryos expelled between the second and sixth months, and injected this serum into patients suffering from cancer. The effect on the living embryonic tissues was most marked, and to some extent the experiments showed cell specificity. Extraordinary effects were sometimes produced. In certain cases the malignant growths were greatly reduced, and for a time the patients were partially relieved from some of the more serious symptoms, especially pain. In spite of this early improvement, however, the patients were not cured. Of late, Fischera has been experimenting to see whether, by inoculation, the tissues of the body could be rendered immune to cancer, just as the development of smallpox is prevented by vaccination. The proofs with regard to this experiment must depend on careful investigations, conducted over long periods, on an enormous number of persons, with proper control.

Carrell's observation is significant, that in the growth of malignant fibroblastic tissue of fowl cancer under glass, there was acid reaction at the progressing margin of growth, whereas in the slower growth of normal tissue it was alkaline.

Passing from the specific reactions connected with these chemical changes which might be multiplied by relevant observations, we come to an important question, that of the fluids of the body, especially as related to the acid-alkali content.

Recent researches by McDonald, at the University of Pennsylvania, appear to show that persons whose reactions are toward the acid side do not often have cancer, as compared with those persons whose reactions are toward the alkaline state. The detection of changes in the acid-alkali balance requires most delicate methods for its determination. The alkalinity of the body tissues, while exceedingly slight, is fixed, and never in life becomes acid. Cell growth is accelerated by a preponderance of the element sodium and inhibited by an excess of the element calcium, which brings up the question of the parathyroid hormone, in relation to calcium reserve in the blood and tissues.

The rather curious relation of the acid-alkali balance of the body to growth also is deserving of study. Seventy-five per cent. of the human body is composed of water, and much of this water is in a bound state. Unbound water is only slightly compressible, but when it is adsorbed with silica, a certain proportion of it becomes bound, and thereby is reduced in volume to 75 per cent. of the original volume. Gortner, the eminent agricultural chemist, of the University of Minnesota, in working out the question of bound water, found that plants which froze readily contained much unbound water which could be squeezed out in a press, and that, on the contrary, in those plants that would not freeze in continued cold weather, the water content was largely bound. This was also true of desert plants. These observations provide an easy test as to what plants would be suitable for regions of the country that had either prolonged winter or excessive dryness.

The essential alkalinity of the human body is very slight and extremely refined methods are required for differentiation. It is comparable to the difference between ordinary tap water and distilled water, and the distilled water must not be exposed to the air, or it will absorb acid from the atmospheric carbon dioxide. No gland in the human body produces an acid. We think at once of the hydrochloric acid of the gastric cells, but it has been demonstrated by Harvey and Bensley that this acid is formed not in the gland substance, but in the acini of the glands by the union of the necessary chemical elements. Acidity of the large intestine depends upon bacteria.

In the study of the cause and prevention of malignant disease biologic phenomena of a biochemic nature assume an importance which only recently has been recognized.

Cancer never develops in sound tissues. Chronic irritation, by opening up an atrium for possible entrance of microorganisms to the body from the outside, seems to suggest an external agent. This does not explain why in certain cases in which the sources of chronic irritation are very slight, cancer develops, while in others in which the sources of chronic irritation are very extensive for great lengths of time, cancer does not develop. It is difficult to surmount the fact that when cancer has extended by metastasis to a new situation, it produces the histopathologic picture of the tissues in which it originated, rather than that of the organ which became affected secondarily. If the disease were due to a foreign invader, it presumably would reproduce the type of cells of the newly invaded tissue rather than that of the primary seat of the tumor. In any event, the agents which act on the cell to produce malignancy become an integral part of the cell itself, as metastasis in the human species takes place only by transplantation of the cell.

One factor of supreme importance which has not been sufficiently stressed is that individuals vary in their susceptibility to the cause or causes of cancer, whatever they may be. In no other way can we explain why 90 per cent. of persons do not have cancer and 10 per cent. die from it. It is as logical to accept the hypothesis that 90 per cent. of persons have greater resistance

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to cancer than the 10 per cent., as to attempt to force an explanation that only 10 per cent. come in contact with hypothetical causative agents.

If the patient's susceptibility to the disease is the important factor in the development of cancer, the situation of the growth must be determined by the organ or tissue subjected to the insult of the precancerous lesion, and the grade of malignancy and the metastatic possibilities by the susceptibility of the body as a whole.

The studies of Murray on tar painting, those of Gye and Barnard on the transplantation of the Rous fowl toxin, the work of Slye on cancer in mice, and of Bowing and Desjardins on the effect of radium and X-ray in lessening the malignant character of the growth, all point to local and general susceptibility as being perhaps the controlling factor in the genesis of malignant conditions, and indicate that the possibilities of increasing resistance to cancer in the more susceptible individuals is not only a possibility but a goal which every effort must be made to reach.

HOMOTRANSPLANTATION AND THE SEVERAL BLOOD GROUPS

CONSIDERATIONS ON EPIDERMAL GRAFTS MADE BY THE THIERSCH METHOD

BY WLADYSLAW DOBRZANIECKI, M.D.

OF LWÓW, POLAND

FROM THE SURGICAL CLINIC OF THE JOHN CASIMIR UNIVERSITY, PROFESSOR HILARY SCHRAMM, DIRECTOR

THE free transplantation of human tissues constitutes one of the most recent triumphs of surgery. The process dates scarcely as far back as the second half of the nineteenth century. Ollier (1858), Reverdin (1869) and Thiersch (1886) were the earliest pioneers in free grafting of the skin, practiced by them clinically. Although certain ideas formulated by them and others have at present merely historical interest, it is nevertheless true that free transplantation of the skin, in which they took the initiative and which was developed later in another direction and with critical elaboration by Marchand, Braun, Lexer and Schöne, constitutes a splendid page in the evolution of modern surgery. In emphasizing the importance of tissue grafting mention may be made of grafts of the important endocrine glands, of the cornea for replacing areas whose transparency has been impaired by burns, ulcers or grave trachoma, of the appendix after appendical ablation, of the divided urethra, fat grafts used for filling losses in the meninges and spinal cord, plastic operations of the articulations and those designed for esthetic purposes, the transplantation of vessels, tendons, cartilage, bones, nerves and periosteum, and even the experimental grafting of entire extremities or parts of them. Some of these procedures, it is true, are extremely difficult technically and require much experience, while they often fail of complete success functionally, or even anatomically. However, they represent material progress forward toward realization of the surgical idea—which is at first view so simple—of replacing organic defects by tissue identical with that which is absent.

By the term "free graft," we mean a rupture of the anatomical connections of a given tissue and its base and its transplantation to another site on the same individual or another individual of the same or different species. Thus, the term autoplasty signifies the grafting of tissues in the same individual, homoplasty, homeoplasty and isoplasty mean tissue transplantation from one individual to another of the same species, and heteroplasty means the same sort of operation as applied between individuals of different species. With respect to the grafting of inorganic and foreign materials, the procedure has had the term alloplasty applied to it by Marchand.

In the present paper we propose to describe certain details concerning epidermal grafts made by the Thiersch method, and also experiments showing the important relations of the several blood groups to homoplasty. The theoretical and practical foundations of epidermal grafts are principally due

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to Reverdin, who attempted grafting upon healthy granulating tissues. His method consisted of covering areas devoid of skin with small bits of skin from two to six square millimetres in surface. Thiersch modified the method, elaborating a wholly different technic for this variety of transplantation. After a short time, the Thiersch method proved more satisfactory and largely displaced the Reverdin technic.

At present, epidermal grafting is done by the Thiersch procedure, not only for replacing skin destroyed by lesions, burns, electric currents, freezing, trophic disturbances, and the like, but also for repairing conjunctival ulcerations (Everbusch), defects in the mucosæ of the nose, mouth (Thiersch, Esser, Moszkowicz) and larynx, after operations of the middle ear (Politzer) and for plastic treatment of the parotid duct (Perthes). Esser employed Thiersch grafts in two cases for fashioning a subcutaneous œsophagus. The same operator restored the anterior portion of the bladder in malformations (ectopia of the bladder) by lining the internal surface of the abdomen by the Thiersch method and then connecting it with the existing structure of the bladder by means of plastic treatment. In operations upon the urethra, after its excision or in cases of hypospadias, it is necessary to correct local defects by applying the Thiersch procedure. Müller repaired a urethral length of eight centimetres in this way. Similar attempts have been made to cover with skin losses in the tissue of the dura mater, of the mucosa of the bladder and oral cavities, and in plastic treatment in congenital absence of the vagina (Albrecht). However, the last mentioned grafts have given no satisfactory or permanent results.

The original method devised by Thiersch has undergone various modifications with respect to obtaining the necessary skin, the thickness and dimensions of the latter and the preparation of the tissue to receive the graft. Lusk employed vesicating agents in order to obtain cutaneous vesicles, employing for covering purposes the epithelium thus separated from the underlying base. Mangold has offered, as a new method, that of sowing, or scattering, over the defective area fragments of skin contained in an epithelial suspension or broth (*Epithelbreiaussaat*). In its final period, this method is in no way different from that of Thiersch, clinically or histologically, and is applied in the same conditions, practically. Among the more curious of the rather unfortunate effects accompanying this method we may mention the case presented by Hacker, in the treatment of the nasolacrimal duct. After introducing the epithelial suspension into the duct on a silk thread, the latter was worked through the duct several times and then left there for four weeks. Withdrawal of the thread formed a new canal.

Pels-Leusden and Reschke injected the epithelial broth or suspension into granulations which had not been cleansed superficially. After some two or three days, the granulating surface became clean, while islands of epithelium were formed here and there. In a case of trophic ulcer, Hilarowicz formed small pockets along the lips of the lesion, beneath the epidermis, and filled

them with the suspension. This method gave good results even in cases where peri-arterial sympathectomy failed of complete success.

Westhnes cut Thiersch grafts into small bits and threaded them into a needle, drawing them into the granulating surface pierced in this way. A part of each bit was thus left above, and another part below, the granulating area. The grafts became fixed and adapted after two or three days. The granulations were then removed and regeneration of the epidermis occurred very rapidly.

Gohrbandt advises the use of grafts which are intermediate between those of Thiersch and those of Braun. Schläpfer considers the Thiersch technic suitable only for truly aseptic wounds. In the presence of suppuration or of presumed latent infection, Schläpfer prefers grafts of the Reverdin-Halsted type (for use in cavities affected with chronic osteomyelitis, X-ray burns, and the like). Braun introduces small Thiersch grafts four or five millimetres square into the interior of the granulation if the patient is restless or if the granulation is impure. Advancing from below, the epithelium makes its way through the granulation and spreads out upon the granulating surface, whatever the situation of the epithelium in relation to the surface. Braun claims success in 90 per cent. of the cases, even if the granulating surface be very dirty. Mannheim similarly recommends for these cases the technic of Braun, rather than that of Thiersch.

As a general rule, epidermis for grafting is obtained from the external surface of the thigh or shoulder. Thiersch states that granulating surfaces may also be covered with epithelium taken from the lips or edges of the wound, whose central portion is thus covered. The denuded portion of the edge becomes repaired in a natural way in two or three days. Thiersch grafts may be obtained similarly from mucous membranes. Krusius grafted single hairs for forming eyelashes.

In cases where the tissue receiving the graft is not sufficiently freshened or bears no granulations, most operators advise curettage of the granulating surface. Others graft directly upon the granulations. Reschke believes that the epithelium has a certain purifying effect upon granulations, changing the appearance of the dirtiest wound so that it is altered and completely unrecognizable in two or three days. Braun shares this opinion and advises that epidermal grafts be applied at intervals of two or three weeks in burns or very febrile cases presenting wounds which are freely suppurating or soiled with urine or fæces. For rendering granulations aseptic, Williams and Clarens employ compresses moistened with Dakin solution, which are removed the evening before applying the graft.

Reschke calls attention to the point that attachment of the graft is promoted by previous application of the Röntgen rays. The same operator injects epithelium beneath the affected part in cases of rodent ulcer and tuberculous lesions of the skin, in order to arrest local nutrition and produce regression of the morbid process present.

It is worthy of remark that grafted epithelium may give rise to cysts.

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Reverdin observed this phenomenon (traumatic epidermal cysts). Klett has recently noted it in applying the Braun technic. The question may therefore be raised as to whether malignant degeneration of the cysts may not occur. Pels-Leusden states that the cells of grafted epithelium are too highly differentiated and too mature structurally to present any marked tendency toward cancerous degeneration.

In grafting skin derived from other animal species (heteroplasty), that of dogs, chickens or the internal pellicle of an egg may be used, and with perfect success, as claimed by some writers. However, our experience, always supported by histological study, causes us to believe that these so-called successes are really merely illusions. The observations in question are not made with sufficient attention or with a sufficiently critical disposition. Heteroplasty has been, in fact, wholly abandoned at the present time, exactly according to the same principle governing blood transfusion, which is also a method of grafting in the larger sense of the word.

Until recently, surgeons have considered homoplasty, or grafting between two individuals of the same species, as something to be taken for granted and having no need of theoretical explanation. The only condition required in such cases was that of close relation or consanguinity. For testing the question, negro skin has been grafted upon an individual of the white race, and conversely. Good results have been obtained (Davis and Guthrie, and according to Lexer), so that certain writers consider homoplasty as equivalent to autoplasty.

The favorable results obtained with homoplasty have led to experiments designed to determine conditions which are essential for successful grafting. It has been proved in this way that, with homoplastic grafts of the skin, the human organism behaves toward the graft, after initial appearances of healing and after two, or at most after three, weeks, as it does toward a foreign body. It either eliminates the graft with pus formation or it renders the graft gangrenous. Degeneration, evident microscopically, and a sign of failure of the graft, appears much sooner. Only embryonic epithelium acts more advantageously in this respect. Experimental studies made with animals have shown that homoplastic grafting of the skin may be accomplished under certain definite conditions. Carnot and Deflander have thus succeeded with guinea-pigs and Schöne with young rats and mice of the same sex. It should be noted, in this connection, that the lower the organism in the phylogenetic scale, the better the results obtained with homoplasty.

The favorable results reported by most writers practicing human homoplasty, and the less certain results indicated by others who have paid special attention to the healing of the grafts, have called attention to the necessity for seeking causes of failure in homoplasty, especially in biochemical differences between the albumins and serums present in different individuals. Such differences may, on the one hand, give rise to a toxic action of the grafted site upon the graft and create a form of immunity toward the grafted tissue or to a foreign albumin, or to one of different value. It has, therefore,

been considered well to utilize, in grafting methods, recent biological advances accomplished in the field of homoplastic blood transfusion, as well as the fact that different blood groups occur in man. The first steps in this direction have been made by American authorities.

The phenomenon of agglutination, as well as the grouping of human individuals according to their types of blood, a grouping which is at present so important clinically, has suggested the idea that grafting upon a given organism certain elements derived from another individual of the same species might be possible without producing any injury in the receiving organism, a condition marking the success now accompanying homoplastic transfusion of the blood. Modern clinical methods attempt to utilize the fact of a certain biological relationship, making use of the blood groups present in different individuals. Clinical observations especially indicate that certain diseases, such as tuberculosis or cancer, appear more frequently in connection with certain blood groupings (Swider, Kohn).

With reference to the homoplastic implantation of Thiersch grafts as associated with utilization of the several blood groups, the literature presents results which are good, and even very favorable. An entire series of operators are now basing success in homoplastic Thiersch grafting upon conformity with, or at last homonymy with, the several existing blood groups. Grafting may be thus rendered surely successful, according to Schowan, Jelanski, Deucher and Ochsner, Kubányi and Dyke, as well as recent writers interested in the subject in conformity with modern problems raised by homoplastic methods and in connection with the blood groups. Deucher and Ochsner have thus noted positive results in two cases involving the same blood groups. According to these writers, the conditions essential for successful grafting are homonymy of the blood groups and youth and consanguinity of the donor. Jelanski has performed seventy-eight transplantations, of which eleven were autoplastic and sixty-seven monoplastic. Histological examination seems to show that, with identical blood groups, the microscopical image is similar to that occurring with autotransplantation. The only difference is that the growth of the epithelium occurs atypically, that cellular infiltration and degenerated forms of epithelial cells appear, and that the graft becomes finally resorbed and serves as a substratum for regeneration of the epidermis. If the blood groups are not homonymous, the transplanted skin is immediately eliminated without the slightest perceptible tendency to regeneration.

In the four cases reported by Kubányi, homotransplantation proceeded in a similar way, the graft not becoming fixed throughout its entire surface, but only as islands of tissue. Necrosed portions were eliminated. Beginning growth of epidermis was, however, visible below and it was finally possible to cover fairly large spaces with Thiersch grafts taken from donors whose blood corresponded to that of the receivers in iso-agglutination. It is a remarkable fact that only the older writers speak of favorable results obtained with homotransplantation and even with heterotransplantation. Key, Davis and Guthrie have observed perfectly satisfactory grafts made from

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negroes to white individuals, and vice versa. Skin taken from fresh cadavers has also been grafted (Bartens), but homotransplantation has usually been performed between members of the same race or family.

Ideas reviewed above have been modified radically as time has progressed. Heterotransplantation has thus completely lost its position in modern scientific literature. Homotransplantation is, as we have remarked, now inseparable from the question of iso-agglutination. While some competent operators believe that homonymy of the blood groups constitutes a condition rendering grafting surely successful, others think that iso-agglutination in no way affects the final result of homotransplantation, which is not favorable. After numerous studies and research, Lexer and his school conclude that, in spite of blood homonymy, every transplant perishes in about fourteen days from dry gangrene, from elimination due to infiltration or suppuration, or from the appearance of a scar. As to the successes which have been reported, Lexer claims that they are not really true or that they have been insufficiently observed.

Eden obtained no result in four cases of homotransplantation of the epidermis, the blood groups being homonymous. In two cases, the grafts appeared to have become well fixed after three weeks, but by the end of the fourth week they separated, on account of the granulation proceeding below them, and finally died. Oshima has also confirmed the point that, while one may speak clinically of seemingly perfect implantation of homoplastic grafts occurring in some sixteen days, such grafts present histological signs of degeneration.

In a case in which the writer did homotransplantation by the Thiersch method in a man, thirty-one years of age, on account of an extensive chemical burn of the third, or even fourth, degree, it was noted that the graft persisted alive, in agreement with the principles of iso-agglutination. The burn affected the entire face. The tissue destroyed included a part of the right cornea, the entire dorsal portion of both hands, including the articulations, the feet and a part of the palms of the hands. The general condition was grave. Blood transfusion was performed, the blood of donor and receiver being of group IV (by the Moss grouping). The transfused blood was taken from a female cousin of the patient, on the maternal side. The patient was affected with a catarrhal state following oedema and irritation of the laryngeal mucosa. This catarrh continued for nearly three weeks. The patient was treated by a dermatologist for a month. During this entire period, the surface of the wound was completely covered with dirty pus and necrotic detritus whose elimination was slow. The extensor tendons of the hands were partially necrotic and fissures were present in some of the digital articulations. The temperature remained constantly at 38.8° C., the grave general condition continuing steadily. Although the wounds were covered with purulent secretion, the denuded regions were covered with Thiersch grafts, without awaiting the occurrence of healthy granulation.

In all cases where the epidermis is lacking over large surfaces, we believe that it is necessary to cover denuded areas as soon as possible, on account of the grave general alterations produced by extensive cutaneous denudation. This attempt should be made by means of any of the various methods suitable in such cases, as we remarked at the outset. It is better to risk only partial

success in grafting than to neglect a grave lesion of this kind, and leave it to its fate. If the wounded surface be covered with abundant secretion, we proceed in the following manner.

For a period of about twenty-four to forty-eight hours we apply compresses moistened with normal saline solution before applying any plastic operation. This we do according to the appearance of the wound and its degree of granulation. The compresses are renewed every two hours. This

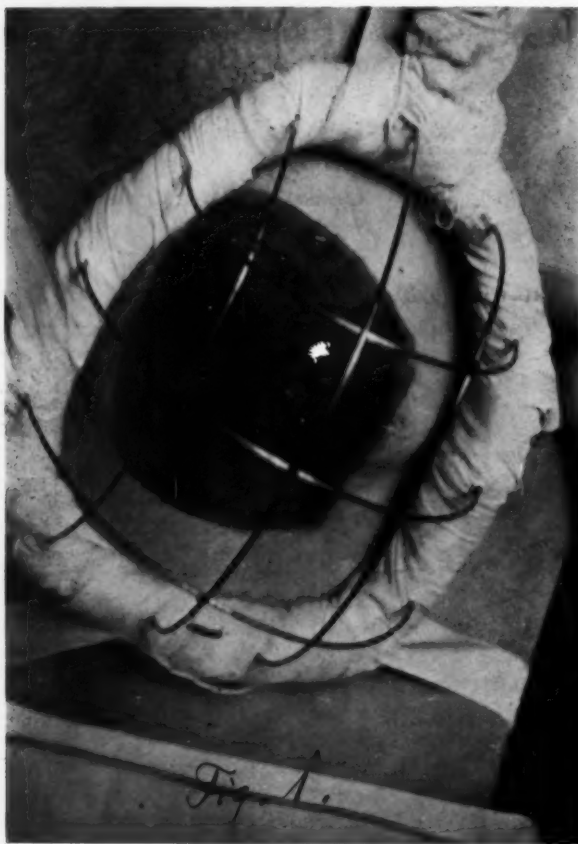


FIG. 1.—The metallic network for the Thiersch grafts.

treatment allows cleansing of the wound. The fibrin which covers the granulating surface sometimes like a membrane is eliminated. The wound does not bleed and cannot give rise to hematomas capable of lifting Thiersch grafts and impairing their vitality. In order to avoid this condition, we never excise or curette the granulations. At denuded sites not yet properly cleansed, the possibility of satisfactorily implanting Thiersch grafts is doubtful. In such cases, we therefore employ capillary drainage of the affected surface, as follows: Before placing the Thiersch grafts, we lay upon the wound parallel threads of catgut, lying two to three centimetres apart. If necessary, we form a sort of meshwork

tending to direct the secretion to the lowest point, due regard being given to the position of the patient. The capillary drains are placed in proper position every day. They are gradually shortened and may be removed in five or six days, at the moment when it is possible for the graft to become firmly united with the underlying surface. This procedure has proved to be perfectly effective in cases of suppuration of the granulating surface. We used it several times in the case mentioned above, as well as in other cases, as, for example, in a plastic operation required for repair of losses following a large carbuncle; in cancer of the breast with secondary complication; in separation of the edges of a wound through suppuration; in lesions of the alæ nasi

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originating in the nasal cavity, and in similar conditions. We employ this procedure whenever circumstances permit. We naturally refrain from using it in cases where it is probable that the graft can be implanted directly, and without preparation. As for the treatment applicable after covering the denuded area by the Thiersch method, we favor treatment allowing free access of air. Such open-air treatment gives very good results. The region which has been covered with Thiersch grafts is, in turn, covered with a metallic network of large meshes, maintained firmly in place with plaster, which thus quite prevents any slipping out of position. (Fig. 1.) We cover the metal meshwork with a strip of sterile gauge, or with a compress. The meshes permit exact inspection to note whether the grafts remain alive; to permit removal of secretion accumulating at the edges of the wound; to shorten the capillary catgut drains, and the like. Should a serous liquid be secreted beneath the epidermis, as shown by the formation of vesicles, the latter are pierced with a large needle. The reticular bandage mentioned has the advantage over other bandages that it allows no marked quantity of secretion to accumulate upon the skin, that it obviates maceration of the grafts, and that, when the bandage is changed, no risk is incurred of loosening already adherent epidermis. Wydler employs thin arcs of cork, and Halsted employs silver leaf, for covering the transplanted epidermis.

In cases where it is impossible to be absolutely sure that an epidermal graft will remain immobile until success finally occurs, as, for example, in a nasal cavity, we suture the borders of the graft to the surrounding skin, using sterile sutures of silkworm gut, or horsehair. The latter are preferable to sutures of silk or catgut in that they do not absorb the secretion.

With respect to anæsthesia of the lateral surface of the thigh (the local nerve being the *n. cutaneus femoris lateralis*) for removal of the epidermis, the method devised by Nyström is insufficient. For this reason, we make injections about the selected site. A point of great practical importance is the fact that neither the tincture of iodine nor the more recently employed antiseptics, such as yatren or rivanol, have any harmful effect upon the vitality of the transplant. (Kamey.)

Here we should remark that in cases where good esthetic results are especially desirable the entire surface should be covered with a single Thiersch graft, as far as possible, for the application of a number of small pieces gives rise to the formation of a honeycomb structure, or raised borders, occurring at the edges of the different pieces in question. The Thiersch grafts must be stretched out upon the bed prepared for them, otherwise folds occur which persist in spite of massage. If the wound is a soiled one, grafting should be attempted only when the edges of the wound have begun to adhere locally and when proliferation of the epidermis has already begun.

In practice, it is necessary to bear in mind certain conditions which appear only some two weeks after the transplantation. Perfect implantation of the graft by no means completes the process occurring in the substratum.

The changes referred to appear clearly when the open surface is large, proliferation occurring, with formation of a scar. In our case, the scar of this kind displaced by a third of the edge of the hair upon the patient's forehead. Having had a high forehead before existence of the lesion and its treatment, the patient perceived, after a few months, that his forehead had become lower.

Bits of epidermis grafted by the Thiersch method become of a pale pink color immediately after adhesion is complete, and preserve this coloration. In our patient, no grimaces or marked facial movements were possible for a period of five months. Sensation in the grafted parts began to reappear toward the end of the third month. After the sixth week, parts covered with the Thiersch grafts were paler than the surrounding skin, were very



FIG. 2.—The entire face covered with the Thiersch grafts.

mobile in relation to their sites, could be folded, were dry and shining, did not resemble normal skin, could bear either high or low temperatures, had no tendency to produce fissures or to ulcerate, and were not different from normal skin so far as sensibility was concerned. The honey-combing formed between sections of the skin had wholly disappeared. (Fig. 2.)

In the same case we employed the Thiersch technic, applying autoplasty with one hand and homoplasty with the other, as it was impossible to graft skin on the denuded cutaneous areas because of supuration and on account of the gravity of the general condition. We did both operations at the same sitting, in order to be able

to follow up, directly and in a parallel way, the implantation of the identical and the foreign grafts. In the regions grafted conditions were identical and the dimensions of the denuded areas were the same (fifteen by thirty centimetres). For the homotransplantation we used epidermis taken from an individual of the same age as the patient and of the same blood group (group IV, as classified by Moss). The patient was a Hebrew. Eight days after operation, the homotransplant appeared well fixed, as also did the autotransplant. As compared with the graft taken from the patient, the homotransplant bore a much greater resemblance to the normal skin, the autotransplant being of a livid hue. It was curious to observe that, after the sixth day, skin was shed through the entire extent of the homotransplant, the epidermis loosening in large flakes, while the epidermis derived from the patient was shed only in small scales. After six weeks, the homotransplant remained solidly attached to its bed, as proved by the fact that it could not be lifted from its site and formed wrinkles when the arm was extended. During the seventh week, the epidermis began to take on a livid color, the

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bed of the graft had acquired a spongy consistency and, exactly forty-one days counting from the day of grafting or, in other words, in six weeks, the grafted segment began violently to yield to necrosis, which rapidly extended from the circumference toward the centre. Five days later the entire denuded area was without epidermis and covered with an unhealthy and impure granulating surface. Here it was necessary to perform, later, an autotransplantation, after previous cleansing of the wound.

This case merits attention because the homoplastic graft seemed to be becoming progressively implanted during a period of six weeks. According to Lexer, all grafts perish in three weeks and histological examination reveals signs of degeneration by the eleventh day, the epidermis becoming detached from its bed, the nuclei taking no stain and a young granulating tissue appearing; and Lexer states that these conditions occur regardless of all circumstances duly provided to assure success, such as conformity to blood groups, consanguinity, identity of race, and similar factors. From material which he has collected Lexer draws the conclusion that those who report successful homotransplantation are mistaken or have not made adequate observation. If the denuded area is small, epidermis supplied by the patient proliferates from the edges of the denuded area to points lying below the graft and covers the wound by imitating the conduct of foreign epidermis. Schramm, my chief, practiced homoplastic grafting of the epidermis thirty years ago, in several hundreds of cases. Because of the ideas then prevalent, he duly considered the factors of age, sex and consanguinity. Never in a single instance did he obtain the result desired, because the grafts always became necrotic before the end of the first week.

The question of homotransplantation has been considered, during recent years, upon a larger basis, especially in connection with blood transfusion and iso-agglutination. At all events, it is legitimate to affirm that the vitality of the graft may be prolonged in its new medium by creating conditions similar to those existing in its original environment, as shown by our concrete case. Among other necessary conditions, homonymy of the blood groups must also be utilized. The possibility of homotransplantation has thus far been demonstrated only in twins originating in the same ovum. According to Bauer, these twins represented individuals who were constitutionally identical and who were a form of reciprocal copy in all respects, concerning height and size, blood grouping (both belonging to group II, of the Moss scheme), dimensions of all corresponding peripheries, finger prints and other characters. In Bauer's case, in which the twins presented syndactyly, a bit of skin measuring five by 1.2 centimetres was taken from one twin for grafting upon the other. In order to check the result, autotransplantation was done upon one of the twins. The favorable results obtained were identical. In view of this exceptional case, Bauer expresses the opinion that the grafting of entire organs should be practicable under the conditions present in his case.

Opinions differ concerning the causes producing failure of homotrans-

plantation. Oshima thinks that biochemical differences in the blood serum of the receiver act upon the graft in a way thus far unknown, producing degeneration, while a group of other factors leads to the occurrence of non-bacterial inflammation in the tissues about the graft, the result being necrosis and elimination of the graft. Schöne thinks that necrosis of the graft is due to a toxic action in the tissue juices, accompanying local or general immunity to foreign tissue, or that the graft succumbs from inanition, owing to a lack of material necessary to life or to incapacity of assimilating necessary nutritive substances. The fact characteristic in these cases is, that in the higher animals and even in those existing under parabiotic conditions, homotransplantation has not given better results when performed by free or pediculated plastic treatment.

The causes of failure in attempts at homotransplantation should doubtless be sought elsewhere than in the blood, for clinical and experimental efforts at the implantation of grafts present biological proof which is more sure and more delicate than that derived from serologic analyses dealing with precipitins, iso-hemolysins and iso-agglutinins. According to Ribbert and Ehrlich, the reason for favorable results obtained with homotransplantation is referable to biologic differences in the leucocytes of the individuals concerned. Eden remarks that the absence of positive results is due to alterations produced traumatically in the local agglutinative conditions of the substratum.

We are at least obliged to prolong as much as possible the life of the homotransplant. Here the blood serum has a very important influence. The studies made by Kubányi and Jacob show that, even with explantation, various tissues remain alive for a longer time when placed in blood serum of the same group, surviving for seven to eight days, and perish sooner if placed in serum of a different group, in which they live only two to three days. In cases of homotransplantation, Baetzner and Beck inject, in increasing doses, the serum of the donor and the extract of a given organ, with the idea that in this way they may turn aside antibodies formed against the graft, the antibodies thus uniting rather with the serum and extract injected than with the cells of the homotransplant. Such are some of the ways employed by students in seeking methods for prolonging the life of the graft. Lexer was able to maintain graft-survival for eight weeks by adding the serum of the donor.

Others have succeeded in retarding the death of transplanted epidermis by employing metallic saturation. Lehman and Tamman made use of electro-collargol, while Tamman and Patrikalakis employed colloidal copper.

Experience has proved that if the superior cervical sympathetic ganglion, as well as a portion of the sympathetic trunk, be removed, necrosis of the graft and healing of the wound occur more rapidly with homoplasty, but that autotransplants adhere much more exactly and with fewer difficulties. Tinozzi explains this fact by increased blood flow directed to the necessary point.

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Williams has reported the completest case published concerning the preservation of an autotransplanted graft. He describes the aspect of a graft thirty years old, differing from the surrounding tissues in that it was much less sensitive and much dryer than the surrounding parts. It was, however, perfectly satisfactory from the esthetic viewpoint.

Summarizing, we may say that, although we do not yet know how to create conditions necessary for assuring the fixation of a homotransplant, we can nevertheless prolong its life by selecting suitable blood groups, by injecting the blood serum of the donor and by applying metallic saturation to the graft while it is still alive.

BIBLIOGRAPHY

- Albbrecht: Deutsche Zeitschrift f. Chirurgie, vol. cxxii, 1913.
André: Contribution à l' étude des greffes cutanées, Paris, 1920.
Baetzner and Beck: Zentralbl. f. Chirurgie, No. 5, 1928.
Bartens: Berlin. Klin. Wochenschrift, No. 32, 1888.
Bauer: Bruns' Beiträge. vol. cxli, 1927; Zentralbl. f. klin. Chirurgie, No. 13, p. 801, 1928.
Braun: Medizin, Klinik, No. 14, 1921; Zentralbl. f. Chirurgie, No. 52, 1920.
Carnot and Deflander: Quoted by Oshima.
Davis and Traut: ANNALS OF SURGERY, vol. lxxxii, 1925.
Deucher and Ochsner: Archiv f. Klin. Chirurgie, vol. cxxxii, 1924.
Dobrzaniecki: Polska Gazeta Lekarska, No. 50, 1927; Polski Przegląd Chirurgiczny, 1929.
Eden: Zentralbl. f. Chirurgie, No. 51, p. 1855, 1921; Deutsche med. Wochenschr., No. 3, 1922.
Elanski: Zentralbl. f. Chirurgie, No. 28, p. 1519, 1924.
Gohrbandt: Archiv f. klin. Chirurgie, vol. cxxxix, 1926; *ibidem*, vol. clii, 1928.
Hacker: Zentralbl. f. Chirurgie, No. 15, 1918.
Herman: Kilka wykładów o wolnem przeszczepianiu i o włączaniu w krążenie tkanek, gruczołów, narządów i kończyn, Lwów, 1914.
Hilarowicz: Zentralbl. f. Chirurgie, No. 40, 1924; Polska Gazeta Lekarska, No. 47, 1924.
Kameya: Zentralbl. f. Chirurgie, No. 37, 1928.
Klett: Archiv f. klin. Chirurgie, vol. cxxi, p. 235, 1922.
Köhler: Deutsche Zeitschr. f. Chir., vol. xlvii, 1897.
Krusius: Deutsche mediz. Wochenschr., No. 19, 1914.
Kubányi: Archiv f. klin. Chirurgie, vol. cxxix, 1924.
Kubányi and Jakob:—*ibidem*, vol. cxliv, 1927.
Laqua: Klinische Wochenschr., No. 29, 1929.
Lehman and Tamman: Bruns' Beitr., vol. cxxxv, 1926.
Lexer: Archiv f. klin. Chirurgie, vol. xcv, 1911; Die freien Transplantationen Stuttgart, 1919; Münchener medizin. Wochenschr., Nos. 37 and 38, 1913; Zentralbl. f. Chirurgie, No. 51, p. 1856, 1921.
Mangold: Deutsche mediz. Wochenschr., No. 48, 1895.
Mannheim: Archiv f. klin. Chirurgie, vol. cliv, 1929.
Moszkowicz: *ibidem*, vol. cviii, 1917.
Nyström: Zentralbl. f. Chir., p. 137, 1909.
Oshima: Archiv f. klin. Chirurgie, vol. clii, 1914.
Perthes: Zentralbl. f. Chirurgie, No. 20, p. 426, 1917.
Poltzer: Wiener. Klin. Wochenschr., p. 328, 1904.
Reschke: Bruns' Beitr., vol. cxxvii, 1922; Archiv f. klin. Chirurgie, vol. cxxi, p. 232, 1922.

WLADYSLAW DOBRZANIECKI

- Rohde: Bruns' Beitr., vol. cxxxiv, 1925.
Schläpfer: Bruns' Beitr., vol. cxxix, 1923.
Swider, Kohn, Mancewiczówna: Polskie archiwum medycyny wewnętrznej, vol. v, 1927.
Tamman and Patrikalakis: Bruns' Beitr., vol. cxxxix, 1927.
Teliga: Polski Przegląd Chirurg., vol. iii, fasc. 1, 1924.
Thiersch: Archiv f. klin. Chirurgie, vol. xvii, 1874.
Tinozzi: Zentralbl. f. Chirurgie, No. 31, p. 1982, 1927.
Westhness: Zentralbl. f. Chirurgie, No. 22, p. 1384, 1926.
McWilliams, Clarence: Jour. Amer. Med. Assoc., vol. lxxxiii, No. 3, 1924.
Williams: Archives of Surgery, vol. xvi, No. 4, 1928
Wydler: Zentralbl. f. Chirurgie, No. 1, 1914.

THE FUNCTION OF THE GALL-BLADDER *

BY JOSHUA E. SWEET, M.D.

NEW YORK, N. Y

THIS WORK WAS AIDED BY A GIFT OF MRS. JOHN L. GIVEN IN SUPPORT OF SURGICAL RESEARCH

SOME years ago I collected the information which was then available concerning the gall-bladder,¹ and was forced by the assemblage of facts to the conclusion that the gall-bladder is an organ of absorption. I expressed my conclusion to the effect that the cystic duct is, under normal circumstances, a one-way tube, "under normal conditions, whatever passes into the gall-bladder through the cystic duct, never passes out again through the cystic duct". By this I did not mean that if, at laparotomy, the surgeon grasps the gall-bladder, and squeezes it with sufficient force, bile could not be forced out of the cystic duct. If the surgeon, under the same circumstances, should apply the same technic to the stomach, he (or his anæsthetist) might conclude, with the same justification, that the stomach empties through the œsophagus.

The facts which led me to this conclusion were derived from the study of the embryologic history of the organ; the development of a remarkably duplicated and folded mucosa; the peculiar and striking blood supply, and the elaborate and relatively large lymphatic system; the parietal sacculi, and their apparent reaction to cholecystectomy; the relation of the muscular coat to the mucosa; the anatomical position; the broad attachment of the gall-bladder to the under surface of the liver, and the two valvular structures at the outlet—the S-shaped curve of the cystic duct, and the curious valves of Heister.

About the same time as my own publication, papers were published by Halpert,² and by Demel and Brummelkamp,³ in which similar conclusions were reached. Halpert⁴ is apparently, like myself, not yet convinced that the point of view is wrong.

Since that time a great number of publications have appeared, designed to prove that the gall-bladder does empty through the cystic duct. I fail to find in any of them a suggestion of an explanation of why such a contrivance is necessary for digestion. If the liver must provide a supply of concentrated bile for the beginning of digestion, why should not the salivary glands, the stomach, the pancreas, have similar provision? Why do the processes of beginning digestion need a more concentrated or a different bile than the later stages of digestion?

Let us examine the methods which have been used in these studies which may be grouped under four general headings. The method of direct observation under varying physiologic conditions has been tried in every conceivable form. The difficulties of this method are perhaps best illustrated by the fact that the most simple suggestion, ligation of the cystic duct, is impossible without interference with the delicate lymphatics which run along the cystic duct, or even a more serious involvement of the blood supply of the gall-bladder.

* Read before the New York Surgical Society, May 8, 1929.

Any method of direct physiologic observation is open, therefore, to the basic criticism that abnormal factors are introduced. Another form of direct observation is to kill the animal and examine the gall-bladder under varying conditions of digestion and so forth. It is perfectly obvious that this method tells accurately only what one sees; if the gall-bladder is found empty and collapsed, that is all it will reveal. It is to be noted in experiments of this type, reported by Mann and Higgins,⁵ that the gall-bladder was not found empty except in those animals which showed, by the injection of the lacteals, that absorption, in general, was in progress.

The second method, which has been very extensively used, is to introduce directly into the gall-bladder, at laparotomy, the iodized oil known as lipiodol. This is an excellent medium, from the standpoint of the radiologist, since the iodine content is so high that a very sharp contrast shadow is produced. But it does not seem to have occurred to those working with it that it is an extremely poor medium for physiologic studies. Lipiodol is not absorbable by any of the membranes of the body. When introduced into a body cavity, such as the joint capsule or the pericardium, it remains, apparently, until it can be removed by a slow process of emulsification and phagocytosis. The illustrations in a recent paper by Whitaker⁶ would indicate that lipiodol is taken up by the mucosal cells of the gall-bladder. The fact that lipiodol would remain for so long a time in the gall-bladder, as shown by the experiments of Graham and his co-workers,⁷ raises the question of whether one should interpret these illustrations in Whitaker's paper as a real absorption, or as an attempted absorption which results in a complete plugging up of this channel.

Therefore, I contend that the use of such a medium in the study of an organ whose function may be absorption, is just as unsuitable, just as incapable of leading to correct conclusions as would be the filling of the upper intestine with bird shot, as a method of inquiring into the function of the upper intestine. Such a filling of the intestine with small particles of lead would undoubtedly give a beautiful contrast shadow, and would undoubtedly lead to the conclusion that the intestine is not an organ of absorption.

The third method of study has been with the use of the dye devised by Graham for cholecystography. This method has many advantages, since the dye can be introduced into the gall-bladder through normal channels, that is, without disturbance of the conditions normal to gall-bladder function. Yet there are certain peculiarities of this method which have not been evaluated in the interpretation of results. It is a perfectly obvious clinical fact, as seen from the oral administration, that this dye can be taken up from the intestine into the circulation, from which it is, more or less, specifically removed by the liver and excreted into the bile stream. It is equally obvious, from the clinical facts, that after intravenous administration the dye follows this same route. The specific value of the substance depends upon the following of this route. Gaining entrance to the gall-bladder, the iodine present in the dye in the gall-bladder casts a shadow on the X-ray plate. Now, if absorption is going on from the gall-bladder—and no one doubts that absorption of water

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is taking place, since probably the oldest known fact concerning the gall-bladder is that the bile in the gall-bladder is more concentrated than the liver bile ^{8, 9}—a water soluble material, such as is Graham's dye, would pass out in solution in this water. This absorbed dye, reaching the circulation would naturally follow the same path.

I believe this is the explanation of the experiment which led Copher ¹⁰ to the conclusion that the gall-bladder must empty through the cystic duct. He found that the shadow persisted after the ligation of the common duct because, he concluded, it could not escape, under these circumstances, from the cystic duct. I believe this experiment can be explained as a constant circulation of the dye, from gall-bladder to blood stream, to liver and back to gall-bladder, as well as by the inability of the dye to pass out of the ligated common duct.

Let us repeat this experiment by introducing into the gall-bladder a substance which, if absorbed, would pass out of the body through other channels than the liver, simply filling the gall-bladder, at laparotomy, with 10 per cent. sodium iodide, and, at the same time, ligating the common duct. A dense shadow of the gall-bladder appears, and in one experiment had disappeared at the end of one hour.

Or, let us slightly modify Copher's own experiment. The gall-bladder is filled with a suitable solution of Graham's dye at laparotomy. The common duct is tied below the cystic duct, but above a duct which, in the dog, enters the common duct from the lowest lobe of the liver. Then into the lower end of the common duct is introduced a cannula to which a rubber bag is attached. If the gall-bladder shadow is disappearing by absorption, under the conditions of this experiment, a certain amount of dye will be shunted out of the circula-

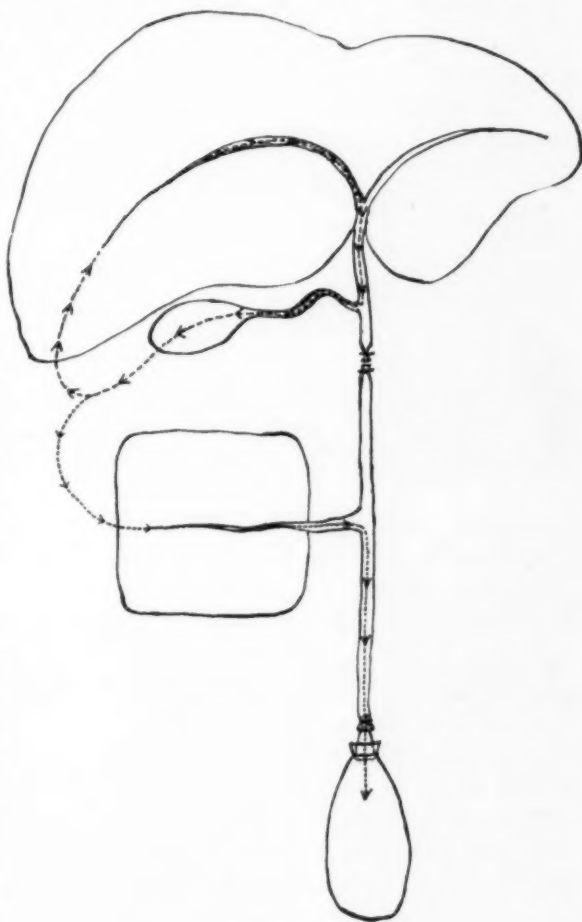


FIG. 1.—Schematic diagram. See text.

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tion into the lobe connected with the rubber bag, and after a time the iodine should have more or less disappeared from the gall-bladder, and be present in the rubber bag.

The details of this experiment are shown in the schematic diagram (Fig. 1), and the results as determined by quantitative analysis of the content of gall-bladder and rubber bag in two experiments are given in Table I.

TABLE I.

	Amount of Iodine Injected into Gall- bladder (Milligrams)	Iodine Recovered in Gall-bladder (Milligrams)	Iodine Recovered in bag (Milligrams)	Shadow of Gall- bladder disappeared at (Hours)
Dog No. 14	330	21	108	24
Dog No. 16	330	37.8	111	26

Therefore it seems evident that the very peculiarities of the iodized phthal-ein, particularly the absorption from the intestine into the circulation, and the more or less specific excretion from the circulating blood by the liver cells, compel the recognition of the fact, that the interpretation of experiments using this dye is not as simple as it might seem.

There is a further condition in the gall-bladder which has not been considered, but which certainly enters into the problem of interpretation. It is, when all is said, a gratuitous assumption, that the shadow seen in the X-ray is necessarily a shadow of the entire gall-bladder at the particular moment. If the dye in the gall-bladder were uniformly distributed throughout the gall-bladder, then the shadow cast by this dye would represent the state of the filling of the gall-bladder at that particular moment. If, however, the molecules of dye were not freely movable throughout the gall-bladder content it is conceivable that a greater concentration of dye might appear in some portions of the content than in others. The shadow cast upon the X-ray plate would, therefore, not represent the actual size of the gall-bladder, but only the shadow of that portion of the bile which contained the iodine in a gall-bladder otherwise filled with bile not containing iodine, or with bile containing iodine in concentration insufficient to cast a shadow.

I believe that such conditions are actually present in the human gall-bladder in most cases. These conditions are not present in the dog's gall-bladder. If one follows the disappearance of dye from the dog's gall-bladder, and in some human cases, it is seen that the shadow does not grow smaller, the density remaining the same, but the shadow remains of the original size, while the density of the shadow becomes less and less until it disappears from view. It seems to me impossible to explain this phenomenon by any theory of elastic recoil or muscular contraction of the gall-bladder. A washing-out process, such as has been suggested, an alternate flowing in and flowing out of bile, might perhaps permit such a result.

On the other hand the usual picture in the human being is hard to reconcile with any washing-out theory. The characteristic and striking feature of

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the disappearance of the dye from most human gall-bladders is that the shadow diminishes in size, retains the original density, but also preserves, in miniature, the contour of the original shadow.¹¹ I cannot imagine any method of emptying, such as muscular contraction, washing out, elastic recoil, which would give this striking result; the only method which could accomplish this is the method of uniform absorption by the entire inner surface of the organ. Elastic recoil would change the shape of the shadow, washing out would disrupt its regularity, muscular contraction



FIG. 2.—See text.

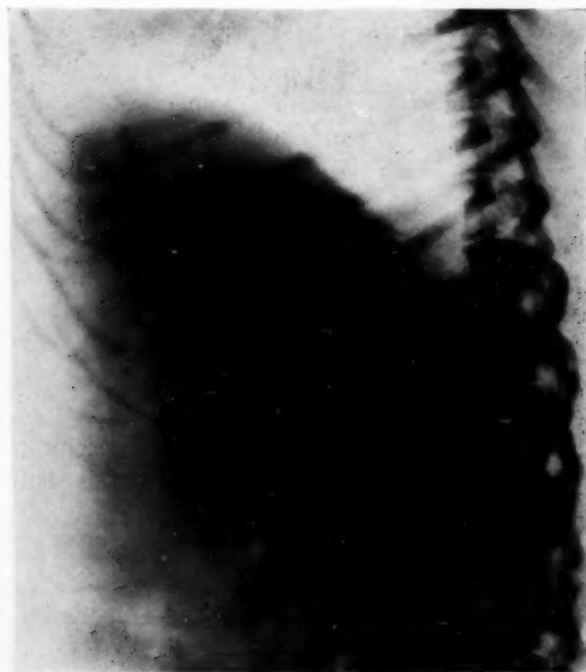


FIG. 3.—See text.

would compel the final shadow to be a shadow of the infundibulum and neck of the gall-bladder.

Absorption of iodine taking place uniformly from the entire periphery of the bile contained in the gall-bladder would explain both types of disappearance of the shadow, the type characteristic of the dog, and the type commonly seen in the human being, the difference depending solely upon the physical character of the bile contained in that particular gall-bladder. Dog's bile is a comparatively thin solution. Human gall-bladder bile is a viscid colloid suspension. In thin bile the molecules of dye can move with sufficient rapid-

ity to keep pace with the rate of absorption. Molecules of dye suspended in human bile are not free to move readily. Absorption from the periphery of such a colloid suspension would permit the appearance of a shadow retaining, in miniature, the original form and original density. Such colloidal suspensions can be produced experimentally by filling the gall-bladder of the dog with dye suspended in gelatin, and such an experiment at least demonstrates the possibility of the theory. In Fig. 2 is shown an X-ray of the gall-bladder of the dog filled with dye suspended in a mixture of gelatin and agar. After several hours the shadow has diminished as shown in Fig. 3. The autopsy at this time reveals a gall-bladder of the original size and shape, which, on being removed from the body and X-rayed, shows an irregular dense shadow much smaller than the actual size of the gall-bladder. (Fig. 4.)

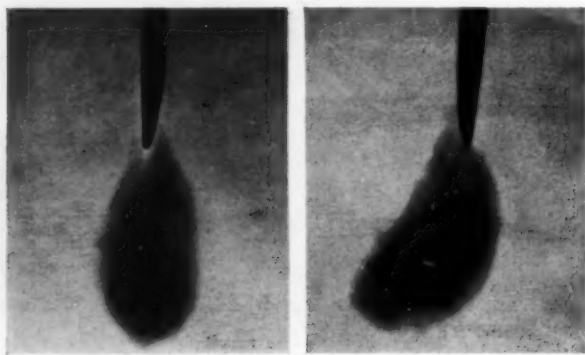


FIG. 4.—See text.

during fasting, and the effect of food, particularly fat, is to be found in the very peculiarity of the iodized phenol phthalein, which makes it of clinical usefulness, *i.e.*, its absorbability into the circulation from either the intestine or the gall-bladder, and the more or less specific removal from the circulating blood by the liver cells. The dye is being brought to the gall-bladder under the conditions of fasting, just as rapidly as it is being removed from the gall-bladder by the process of absorption. Therefore there is no apparent change in the shadow during fasting. When food is introduced into the intestine, the sphincter of Oddi relaxes, the dye-containing bile runs into the intestine instead of the gall-bladder. It must be changed in the presence of food and digestive secretions into a non-absorbable form. This must be the case from the well-known fact that if the dye is given with food no gall-bladder shadow appears.

Food, then, especially fat, accomplishes three things—opens the common duct, breaks the circuit of dye from gall-bladder to blood, to liver, and back to gall-bladder, and changes the dye in the intestine into some form or combination such that it is now not absorbed by the intestine.

The fourth method which has been used to study the gall-bladder function is the combination of the Graham dye, with the method of biliary drainage devised by Lyon. In a recent paper Lyon¹² published results obtained by this

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method, which he believes satisfactorily settle the problem that the gall-bladder does empty through the cystic duct.

Let us take the first six cases from Lyon's table, the results of which he considers entirely satisfactory, together with one case from his second table which enters largely into his discussion of his results, and let us carry Lyon's own figures on to their logical conclusion. (Table II.) He gives the amount of iodine found in each of his bile fractions, and also the total amount of bile recovered in each fraction. A simple multiplication gives us the total amount of iodine recovered.

TABLE II.

3.5 grams or 3500 milligrams dye given to each patient, in capsules. Dye contains 60 per cent. iodine, therefore each patient received 2100 milligrams iodine.

Case Number	Reduction in Size of Shadow	Iodine Milligrams per Cubic Centimetre		Cubic Centimetres of Bile		Milligrams Iodine Recovered		Total Iodine Recovered
		"B"	"C"	"B"	"C"	"B"	"C"	Milligrams
95096	Complete	4.2	2.5	120	210	504	525	1029
95105	"	9.6	0.42	100	300	960	126	1086
95134	"	6.4	3.2	140	500	896	1600	2496
95136	"	8.4	0.8	192	476	1612.8	380.8	1993.6
95137	"	3.4	1.3	125	400	425	520	945
95171	"	9.5	1.1	175	750	1662.5	825	2487.5
95172	½ after B. D.*	19.6	3.2	100	400	1960	1280	3240

Duration of drainage averaged three hours and ten minutes, although in most cases all of the "B" bile was recovered within the first ninety minutes.

*B. D. indicates reduction in size of shadow after biliary drainage.

It must first be remembered that Lyon gave each of his patients in these experiments three and one-half grams of dye, and that the dye contains approximately 60 per cent. of iodine.¹³ Therefore each patient received 2100 milligrams of iodine. In the first, third and fifth cases in which I have carried out these simple calculations the "C" bile contains more iodine than the "B" bile. If the "C" bile is liver bile, whence comes this iodine? In the third and sixth cases Lyon has recovered more iodine than he fed his patients. And in the last case which I have taken from Lyon's second group, the figures show that he has recovered 3240 milligrams of iodine, after giving the patient only 2100 milligrams, and in addition he states that in this case the shadow of the gall-bladder, after biliary drainage, had been reduced to only one-half the original size.

But granting the correctness of the observations of Lake¹⁴ and Lyon, that there is more iodine in the so-called "B" bile than in the so-called "C" bile, it does not necessarily follow that this iodine comes directly from the gall-bladder. If absorption is going on, it will naturally be more rapid if the gall-bladder is entirely filled with the dye, since the total surface upon which absorption is acting will be much greater. Therefore, the amount of dye

excreted by the liver in the early stages of absorption from the gall-bladder would be greater than in the later stages, but since the source of the iodine is the same, the "C" bile also contains iodine.

I stated at the beginning that one of the faults I find with the theory that the gall-bladder empties a concentrated bile into the intestine at the beginning of digestion is that no one has offered a suggestion as to the purpose of such a scheme. You may, therefore, properly ask me now, what do I think would be the purpose of an absorptive function of the gall-bladder? For some unexplained reason the body carefully conserves certain of the bile constituents; the bile acids are quantitatively returned to the body; cholesterol is apparently carefully conserved. The liver is secreting constantly, but between the periods of active digestion there is no reason for bile to flow into the intestine, and possibly the resting intestinal mechanism is not in position to carry out this conservation of biliary constituents. I therefore suspect that the function of the gall-bladder is to receive and return to the body the bile which is formed during the intervals between active digestion, the purpose being to conserve these biliary elements during a period when they might otherwise be lost.

It is possible that the essential function of the gall-bladder is to carry out this same process during the months of foetal life, when no digestion is going on in the intestine. Such a concept would explain the occurrence of icterus neonatorum; the foetal bile circulation through the gall-bladder continues, but the bile pigments are not removed from the foetal circulation by the placenta. Therefore, a jaundice occurs until the introduction of food into the intestinal tract opens the papilla of Vater.

Such a concept might explain the fact that foetal blood regularly shows a hyperbilirubinemia. It would explain the physiologic hyperbilirubinemia of pregnancy¹⁵ as well as the steady increase of bile salts in the blood of pregnant women¹⁶; herein might also be found, possibly, an explanation for the well-established relationship between pregnancy and gall-stone formation.

That the gall-bladder absorbs is admitted by all; that the gall-bladder can absorb all the biliary constituents is proven by the hydrops of the gall-bladder; that the rate of absorption is very rapid is proven by the experiment I have shown you with sodium iodide. The shadow of a gall-bladder filled with 10 per cent. sodium iodide, and with the common duct tied can completely disappear in an hour.

I have hesitated for a long time to insist upon my point of view in the face of so much work which seems to have satisfied everyone, because it perhaps makes little difference in the interpretation of the results whether the gall-bladder empties through the cystic duct or not. Nevertheless, the evaluation of so important a method as cholecystography, and the determination of the indications for surgical interference must, in the end, rest upon a basis of physiological fact.

If the gall-bladder empties through the cystic duct, the element of "stasis" enters into the problem of gall-stones. If the gall-bladder is an organ of absorption, gall-stones will appear, if this absorbing mechanism is incompe-

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tent, as in cholecystitis; or, if the material coming to the gall-bladder is abnormal, that is, non-absorbable. And then we will have what the surgeon not infrequently sees, and what is so often found in the autopsies of people past fifty years of age—gall-stones in a perfectly normal gall-bladder.

It will then have to be admitted that gall-stones are not necessarily a product of the gall-bladder,—in fact are uncommonly a gall-bladder product; and, therefore, the removal of the stones, or the removal of the gall-bladder, will not necessarily cure the patient of his basic disease.

BIBLIOGRAPHY

- ¹ Sweet: *Int. Clin.*, No. 1, Series 34, p. 187, 1924.
- ² Halpert: *Med. Klin.*, No. 20, p. 408; also p. 1830, 1924.
- ³ Demel and Brummelkamp: *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, vol. xxxvii, p. 515, 1924.
- ⁴ Halpert: *Arch. of Path.*, vol. vi, p. 623, 1928; *Arch. of Path.*, vol. vii, p. 471, 1929; *Am. J. of Phys.*, vol. lxxxviii, p. 351, 1929.
- ⁵ Higgins and Mann: *Surg. Clin. N. A.*, vol. vii, p. 1541, 1927.
- ⁶ Whitaker: *Arch. Surg.*, vol. xviii, p. 1783, 1929.
- ⁷ Graham, Cole, Copher and Moore: *Diseases of the Gall-Bladder, Etc.* Lea & Febiger, Philadelphia, pp. 72ff., 1928.
- ⁸ Heister: *Compendium Anatomicum*, Amstelodami, 1728.
- ⁹ Rous and McMaster: *J. Exp. Med.*, vol. xxxiv, p. 47, 1921.
- ¹⁰ Copher: *J. A. M. A.*, vol. lxxxiv, p. 1563, 1925; also see bibliographical reference No. 7, p. 68.
- ¹¹ Case: *J. A. M. A.*, vol. xcii, p. 293, 1929.
- ¹² Lyon: *Arch. Int. Med.*, vol. xliii, p. 147, 1929.
- ¹³ See bibliographical reference No. 7, p. 59.
- ¹⁴ Lake: *Am. J. of Med. Sci.*, vol. clxxiv, p. 786, 1927.
- ¹⁵ Schlüns: *Zentralbl. f. Gyn.*, vol. 1, p. 2185, 1926.
- ¹⁶ Hofbauer: *Am. J. Obst. and Gyn.*, vol. xvi, p. 157, 1928.

TEMPORARY BILATERAL ABDUCTOR PARALYSIS WITHOUT NERVE INJURY AFTER THYROIDECTOMY *

BY FRED W. RANKIN, M.D.
OF ROCHESTER, MINN.

FROM THE DIVISION OF SURGERY OF THE MAYO CLINIC

TO INJURE one recurrent laryngeal nerve during resection of the thyroid gland is an unfortunate accident; to injure both nerves is a tragedy. To have bilateral abductor paralysis develop post-operatively, when an immediate check on this condition of the cords has shown that the nerves had not suffered direct surgical trauma, is a disagreeable and unhappy incident, and yet, withal, endurable.

In the goitre service at The Mayo Clinic, in the last two years, during which 4249 thyroidectomies have been performed, post-operative bilateral paralysis of the cords, without injury to the nerves, has been observed in two cases, as proved both by tests of the cords immediately after operation, and by the subsequent clearing of the undesirable complication. Occasionally, despite utmost endeavors to control the technical steps of thyroidectomy, surgeons are unfortunate enough to injure one recurrent laryngeal nerve, with resultant paralysis of the cord on that side. Injury of both recurrent laryngeal nerves should never occur. I have not encountered such a complication in my service.

The most significant technical features of thyroidectomy are avoidance of injury to the recurrent laryngeal nerves and establishment of accurate hemostasis. The two steps are so intimately associated that the type of technical manoeuvre is modified to avoid the one and to accomplish the other. That is, in The Mayo Clinic it is the custom to perform subtotal thyroidectomy, with removal of the isthmus at the same time, but the operation is done as double lobectomy in one stage, with the assurance that after removal of the first lobe the nerves have not been injured, as is evidenced by the type and pitch of the patient's voice on speaking or coughing. Adequate exposure and satisfactory mobilization allow resection of the lobes; the operation is carried out entirely above the level of the trachea, and a nerve is rarely injured by the clamps which are applied for hemostasis. I believe that a nerve is injured most often following some type of hæmorrhage, either venous, or the more alarming arterial hæmorrhage which sometimes occurs from breaking off the main trunk of a vessel such as one of the inferior thyroid vessels; this is more likely to occur in arteriosclerotic persons. When such hæmorrhage occurs, one has an almost uncontrollable desire to grasp the tissues around the bleeding point with one or many forceps and this frequently results in injury to the nerves. It is a better plan quickly to press the fingers or a gauze sponge into the neck to hold the

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hæmorrhage, removing the pressure slowly and securing the single bleeding point; or if the hæmorrhage is arterial, to hold the pack tightly in the neck with one hand and go back to the source of the inferior thyroid vessel near its origin from the thyroid axis, securing the main trunk with a single ligature. Such a procedure avoids direct surgical trauma to the nerve but may result in indirect trauma from the pressure or subsequent inflammatory reaction in the neck, secondary to the necessary surgical insults to control the hæmorrhage. To proceed with resection of the second lobe without knowing the condition of the nerve on the first side, courts bilateral paralysis, although, fortunately, this occurs in only a small percentage of cases, and usually in the hands of inexperienced operators. However, to avoid one such tragedy, I am convinced that the type of manœuvre just described is most satisfactory.

Examination of the vocal cords prior to operation is always essential and should never be forgotten by either clinician or surgeon. It is entirely unpardonable to perform thyroidectomy in any case without full knowledge before operation of the condition of the vocal cords. Examination of the cords as a routine prior to operation has elicited the fact that a small percentage, about 1 per cent., of persons as they appear for the examination of conditions not related to the thyroid gland, have unilateral paralysis of the vocal cord.

In two cases, abstracts of which are appended, operation was carried out in the usual manner, that is by double resection and removal of the isthmus. Prior to operation, examination of the cords by the laryngologist showed them to be moving normally in both patients. The immediate post-operative examination likewise showed both cords to be moving normally. There was no evidence, either when the patients were on the table or immediately after operation, that the recurrent laryngeal nerves had been injured. Twelve to twenty-four hours later, aphonia, dyspnœa and difficulty and choking on swallowing called attention to a condition which was of varying intensity in both cases, depending on the amount of encroachment on the air space.

It is interesting to speculate on the reason for the appearance of temporary bilateral abductor paralysis in these two cases in which direct injury to the nerve, the usual cause, can be so definitely ruled out. The most likely explanation, I believe, is that œdema or reaction in the tissues occurred in immediate juxtaposition to the nerves, secondary to the necessary surgical trauma of mobilization of the thyroid gland. The gland in both cases was rather high-lying, and mobilization of the upper pole was perhaps accompanied by more reaction than is usual because of the difficulty in dislodging it downward. It is my practice in removing the thyroid gland to bring down the upper pole, sever it between clamps, and then, with a finger behind the gland, elevate it and at the same time press it mesially so as to control oozing from small branches of vessels not caught by the hemostats. Perhaps the finger manipulation around the inferior constrictors of the larynx and the pressure on the posterolateral tissues of the gland itself and in the immediate

neighborhood of the nerve resulted in an excessive amount of reaction with subsequent œdema and impairment of the function of the nerves. Trauma to the nerves, which is made by pinching or ligation, presents an entirely different problem from that resulting in temporary paralysis of the nerves secondary to operation.

Judd, New and Mann, in 1918, reported the results of certain experiments of traumatizing and ligating the recurrent laryngeal nerve in dogs; they found that ligation of the recurrent laryngeal nerve with linen or catgut produced just as complete paralysis of the nerve on that side as did section. Stretching of the nerve, similar to that which would be observed during operation and of the same intensity, did not impair the function of the vocal cords, but stretching over a longer period resulted in aphonia which, they believed, was due to the operative trauma rather than to stretching. Pinching of the recurrent laryngeal nerve with the hemostat produced only temporary paralysis, and function was always restored, the length of time varying with the severity with which crushing was accomplished. Function was restored usually within thirty days, but sometimes as long as two months was required. These experiments seem to bear out the contention that the operative trauma and reaction in the tissues probably was the etiologic factor in these two cases of temporary bilateral paralysis. Moreover, this experience emphasizes conclusively, I believe, the contention that accurate knowledge of the condition of the vocal cords, both prior to operation and immediately after, is highly essential. The vagaries of events connected with impairment of the nerves, and partial or complete paralysis following thyroidectomy, are still sufficiently unique to encourage report whenever an unusual event of this nature arises.

The checking or testing of the cords was characteristic in these two cases; in one the cords moved normally immediately after operation and in the other they moved normally except for some sluggishness. The fixation evidently came on slowly and progressively within the first twelve hours, during which time the symptoms appeared. The height of œdema and dyspnoea was reached by the afternoon of the second day. Regression and return to normal marked the course in each case, fortunately, and this is proof of the contention that interference with the function of the nerves was inflammatory rather than the result of direct trauma. In neither case was there sufficient dyspnoea and evidence of tracheal obstruction to warrant tracheotomy, although, of course, this possibility was kept in mind constantly, and a tracheotomy set was maintained at hand. The air space had been encroached on extensively in both cases and I should not have hesitated to perform tracheotomy had cyanosis become pronounced or had stridor and labored respiration developed. Early tracheotomy following thyroidectomy, regardless of the cause of its necessity, is not nearly so hazardous a procedure or so prone to untoward complications as late tracheotomy. Indeed, it has been demonstrated repeatedly that if tracheotomy must be done for obstruction, it should be done early, before the heart has become embarrassed by long,

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continued labor against congestion, with consequent depletion of reserve. Both of the patients were placed in the oxygen chamber, which probably militated to a satisfactory outcome.

REPORT OF CASES.—CASE I.—A man, twenty years of age, came to The Mayo Clinic May 11, 1929. Three years previously a diagnosis of exophthalmic goitre had been made. The patient presented the usual symptoms: loss of weight (about eleven pounds), tachycardia, increased appetite, heat intolerance and insomnia. The systolic blood pressure was 150 and the diastolic 80; the pulse was 84 and the temperature 97.9° F.

The patient began taking iodine (Lugol's solution) the day of his arrival. May 13, the basal metabolic rate was +56, and May 17 it was +22. The urinalysis, blood count, and the Wassermann reaction on the blood were negative.

The patient was admitted to the hospital May 21, and subtotal thyroidectomy was done May 22. Each lobe was about five or six times the normal size and the right lobe had a retrotracheal projection. Double resection with removal of the isthmus was done, leaving glandular tissue on both sides amounting to about half of a normal-sized lobe. The pyramidal lobe was well developed and was removed. The muscles were not cut. The pathologic report was hypertrophic parenchymatous thyroid gland with thyroiditis, graded I.

Following operation there was no unusual reaction; the temperature the following day rose to 101° F. and the pulse to 124. Immediately after operation both of the cords were moving but the laryngologists noted that there was sluggishness on both sides. Twenty-four hours after operation the patient began to have difficulty in swallowing, but there was no cyanosis or difficulty in respiration. Examination of the cords, however, showed marked œdema, especially on the right side of the glottis, and both cords appeared to be fixed. The left cord was abducted; the right cord was not satisfactorily visualized. The patient was put in the oxygen chamber and his course was progressively forward from that point. The pulse and temperature did not change markedly and two days later, on examination the œdema was clearing up; the cords were visible and moving slightly, and the breathing space was sufficient. The patient's condition progressed favorably and he was dismissed from observation June 17, at which time both cords were moving normally.

CASE II.—A man, thirty-three years of age, came to The Mayo Clinic June 11, 1928, because of weakness, nervousness and loss of weight (about twenty-three pounds), and a two weeks' history of palpitation and dyspnoea on exertion, and exophthalmos. A diagnosis of exophthalmic goitre was made and June 12, the patient began taking ten drops of iodine three times a day (Lugol's solution). The basal metabolic rate was +46.

The patient was admitted to the hospital June 19, and June 22, subtotal thyroidectomy was done. The lobes were about four times their normal size. Double resection and partial removal of the isthmus was done, with preservation of glandular tissue on both sides amounting to about a fourth of a normal-sized lobe. The muscles were not cut. Pathologic examination showed a hypertrophic parenchymatous thyroid gland.

Immediately after operation both cords were seen to be moving normally. The following day difficulty in swallowing developed, as in the first case, and on laryngeal examination movement was not visualized in either cord. The laryngologists reported that both cords were fixed but sufficient breathing space remained. There was no difficulty with the voice, with coughing, or with swallowing until twelve hours after the operation. It was believed that the late fixation was the result of hæmorrhage or œdema along the trunk of the nerve. The following day the laryngologists reported that the cords looked wider, and that they were apparently about 50 or 60 per cent. normal. Two days later, the breathing space was wider. The patient made good progress following this and he was dismissed from observation July 10, at which time the cords appeared to be normal.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MAY 8, 1929

The President, DR. EDWIN BEER, in the Chair

FASCIA LATA TRANSPLANTATION FOR THE CURE OF VERY LARGE POST-OPERATIVE VENTRAL HERNIA

DR. WALTER M. BRICKNER presented a rather stout man, forty-five years of age, who had been operated on six years ago for "chronic appendicitis." Two weeks after leaving the hospital the man noticed a hernia in the scar. Six weeks later the same surgeon attempted an operative repair but the hernia soon recurred. Since then the patient had had intermittent attacks of abdominal pain and vomiting, lasting two to three days. These attacks at first were several months apart but recently had become more frequent.

When first seen by Doctor Brickner, January 29, 1929, he was just getting over one of these mildly obstructive attacks. His abdomen presented a six-inch longitudinal scar over the right rectus muscle, beneath and chiefly to the outer side of which there bulged a large, irreducible hernia. In circumference and in bulk this hernia would almost fill a derby hat. Abdominal palpation was otherwise negative and so was the finding of a gastro-intestinal X-ray examination.

Operation was performed February 4 under spinal anaesthesia. The scar was excised by free longitudinal incision. The large sac was adherent to the abdominal aponeurosis on the right side and had to be dissected from it. There was a very extensive deficiency of rectus muscle and aponeuroses. Small intestines were found densely and extensively adherent to the sac. One loop of gut was sharply angulated by adhesions and it was released by dividing these. No other adhesions were disturbed. Only that portion of the sac which was not adherent to the intestines was resected, and the peritoneal opening was immediately closed. The hernia was then reduced into the belly. The lower half of the hernial opening was closed by kangaroo tendon sutures approximating the only layer of aponeurosis that was here present. Closure of the upper half was accomplished by longitudinally incising the anterior sheath of the left rectus and reflecting the inner segment over to the right side to effect approximation. There was thus accomplished a complete closure with a single layer of aponeurosis. The deficiency of the second layer, however, was very large—occupying an area seven inches long and five and a half inches wide. A fascia lata transplant, eight inches by six inches, was then cut from the outer and anterior aspect of the right thigh, through a long incision. This transplant, which included much of the tensor fasciae femoris, was stitched snugly over the defect with two rows of chromicized catgut sutures. Both skin wounds were closed with running silk sutures. Hemostasis was perfect in both wounds, and only a few vessels required ligation.

Perfect primary union took place throughout. The man was kept in bed nineteen days. The abdominal wall now appears solidly repaired. He has no pain, or any other abdominal symptom, and he suffers no inconvenience

PERFORATED GASTRIC ULCER

whatever from the loss of so large a portion of his fascia lata. Indeed, it is of interest to observe in these cases that so much of this aponeurotic covering of the thigh muscles can be removed without causing any functional disturbance, even when the tensor fasciæ femoris is also sacrificed.

PERFORATED GASTRIC ULCER; CLOSURE. MULTIPLE DUODENAL ULCERS; PYLORECTOMY. POST-OPERATIVE VENTRAL HERNIA; HERNIOPLASTY

DR. WALTER M. BRICKNER presented a man, thirty-two years of age, who was admitted to his service at the Hospital for Joint Diseases December 28, 1927, with symptoms of perforated gastric ulcer. At operation a small hole was found in the anterior wall of the stomach about an inch and a half from the pylorus. In the upper abdomen there was but a small amount of clear gastric fluid, which was removed by suction. The perforation was closed with two layers of absorbable inversion sutures. The wound, through the right rectus muscle, healed *per primam* and on the fourteenth day the patient was discharged, in good condition, to the Out-patient Department for further observation.

Soon, however, he began to suffer from epigastric pain after eating, with heart-burn and vomiting, so that about two months after his discharge he was sent back to the hospital with a diagnosis of duodenal ulcer. This was confirmed by röntgenological examination which showed, in all films, extensive filling defects involving the lesser curvature of the duodenal cap almost from its base to its apex. The beginning and mid-portions of the second part of the duodenum were dilated. The stomach was normal in size, shape and position and emptied in three hours.

At operation, March 30, 1928, again through the right rectus muscle, the site of the gastric perforation showed only a fine scar. The first portion of the duodenum, however, was now found much thickened and highly inflamed. This portion of the duodenum and a considerable portion of the stomach (certainly including all of the antrum pylori) were resected; and a retrocolic gastrojejunal anastomosis was made by the Polya method, absorbable sutures being used throughout. Section of the duodenum showed two discrete, inflamed ulcers.

On the sixth post-operative day the patient was vomiting and the skin wound had to be reopened at its lower angle to evacuate a hematoma. Thereafter the man did well and was discharged, healed, May 1, 1928.

He continued under close observation in the gastro-intestinal department of the dispensary and in the surgical follow-up, and for the succeeding ten months he reported himself as feeling well, with only occasional gastric discomfort without vomiting, and with considerable gain in weight. He had, however, an incisional hernia the length of the scar.

Returning home from his work on a cold night about March 1 this year he had abdominal pain and vomited after eating; and this vomiting continued until he was readmitted to the hospital two weeks later. He had noticed no blood in the vomitus nor had his stools been abnormal in color; but he had lost four pounds in weight. Under rest in the hospital, however, the pain and the vomiting ceased at once and during a fortnight of observation the patient was eating a quite liberal diet with no distress whatever. Röntgenologic examinations showed: the remnant of stomach as a well-filled tubular organ lying wholly to the left of the mid-line; a well functioning gastrojejunal stoma almost three centimetres in diameter at the right interior angle of the

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stomach; promptly initiated emptying of the stomach, which was complete in three hours; no evidence of a marginal ulcer.

The man thought the hernia was chiefly responsible for his symptoms, and he requested that this be repaired.

For this purpose he was operated on again March 30, 1929. The skin scar, to which the peritoneum was adherent, was excised and the abdominal cavity was entered. Extensive adhesions were exposed. Because the patient had had but a short period of pain and vomiting in a year and had been free from symptoms for two weeks while resting in the hospital, and because the X-ray examinations gave no evidence of an ulcer or a mechanical defect, Doctor Brickner decided not to separate these extensive adhesions to explore the anastomosis, but to be content with the purpose of the operation—the repair of the hernia. The peritoneum and the posterior sheath of the rectus were easily approximated. In the lower angle of the wound the anterior sheath of the rectus was reunited under slight, but not undue tension, with kangaroo tendon sutures. The greater part of it, however, could not be closed except, perhaps, under great tension. Accordingly, two longitudinal releasing incisions, about four inches long, were made, one on each side of the wound, through this aponeurosis, which then at once could easily be sutured.

Primary union followed, and a solid abdominal wall resulted. The patient was discharged from the hospital seventeen days after operation, free from symptoms.

This man has, or had, then, two oval defects in his aponeurosis, made by the releasing incisions, through which the rectus muscle was left exposed. As in the case of the previously presented patient with the large transplant from the fascia lata, this defect appears to cause no disturbance whatever.

The patient has not yet returned to work and has been until now in a Convalescent Home. He reports himself a "feeling fine." The tests of time and of work are yet to come.

DR. SEWARD ERDMAN added his testimony to Doctor Brickner's demonstration of the repair of the mid-line hernia. He understood that Doctor Brickner made use of Doctor Gibson's method of incising the fascia laterally so as to release it. In a number of Doctor Erdman's cases this has been very successful and he felt that one who has seen the results which can be accomplished by a releasing incision in the sheath of the rectus will agree that it is very satisfactory. While Doctor Erdman has used this method more in the epigastric region than in the lower abdomen, on two occasions he has used it below the umbilicus. The defect left in the rectus sheath after operation, he agreed, is sometimes rather alarming to look at, but as in Doctor Brickner's case, it does not seem to impair the strength of the muscle wall. While it is true that the muscle is left exposed at the site of the releasing incision, yet the defect eventually fills in with new fascia.

CONSERVATIVE SURGERY IN CHRONIC OSTEOMYELITIS

DR. WALTER M. BRICKNER said that last year he presented before this society some cases (*ANNALS OF SURGERY*, February, 1929) intended to demonstrate the value of conservative surgery in *chronic* osteomyelitis. They were to show that in cases, for example, with sinuses or soft-part abscess,

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rather than at once attack the bone by a more or less radical osteotomy, it is wiser to wait (so far as the bone itself is concerned) until a sequestrum is fully formed, and then merely to remove the sequestrum or sequestra even though it leaves overhanging bone. Contrary to much teaching, the cavity in the bone, when rid of its dead content, often heals, and stays healed, without requiring the familiar "saucerization."

Tonight he wished to illustrate by two cases from among many the value in another phase of osteomyelitis—the chronic bone abscess—of a simple, conservative operation which for more than ten years he has advocated and practiced with uniform success, viz., drainage through a small drill hole, under nitrous oxide narcosis. This little operation works equally well whether the abscess is medullary or in the bone substance. Of course it is not intended for an abscess that is already discharging through the bone.

CASE I.—A lad, now about twenty years of age, was operated on in 1922 for what was probably a pyarthrosis of the left hip and osteomyelitis of the ilium; in 1926 for osteomyelitis of the left radius and in 1928 for osteomyelitis of the right humerus.

He came under the reporter's care in 1927 because of recurring abscesses and sinuses in the scars about the left hip, through which, occasionally, a sequestrum had escaped. X-ray films (Fig. 1) showed complete bony ankylosis of the hip and the changes produced by an extensive osteomyelitis



FIG. 1.—Bony ankylosis of hip, with iliac osteomyelitis. (Note the two minute incompletely formed sequestra.)

of the ilium. There was evident no gross process needing attack. Two small areas of erosion appeared to contain minute, incompletely formed sequestra. It was decided to treat this case conservatively, draining abscesses as they appeared and allowing such sequestra as formed to escape spontaneously if they would. Accordingly, abscesses have been opened about four times in the past two years, twice with the escape of small bone fragments. The sinuses have healed and no abscess has formed for several months.

In December, 1928, in the follow-up clinic of the Hospital for Joint Diseases, the boy complained of persistent pain in the upper part of the *left* arm, worse at night. There was no redness, swelling or fever, but there was pronounced bone tenderness four and one-half inches below the tip of the acromion. A diagnosis of bone abscess was made. This was confirmed by X-ray examination, which showed an enlargement of the medullary cavity at the

level of tenderness, with encroachment, by bone growth, on the medulla above and below. (Fig. 2.) Through a small anterior longitudinal incision centred four and one-half inches below the acromion, the humerus was exposed and entered with a one-eighth inch drill. There escaped a dram or more of thick pus in which the staphylococcus aureus was found on smear and culture. A rubber dam drain to the bone was inserted and the wound was sutured. The pain ceased promptly; the drain was removed in three days; the wound closed; and there has been no recurrence of symptoms.



FIG. 2.—Abscess of humerus. Sequel to osteomyelitis of ilium. (Same patient as in Fig. 1; one year later.)

CASE II.—Another lad had been operated on several times for osteomyelitis in the lower third of the right femur. He was in the Hospital for Joint Diseases for several months in 1928-1929 with a series of soft-part abscesses—in each arm near the axilla, in the region of the left hip and buttock, and beneath the fascia over the affected femur. Last September, in the hospital, he complained of pain in his left knee and exhibited tenderness in the upper part of the patella. X-ray films showed here a distinct, small, oval area of erosion—a bone abscess. (Fig. 3.) At operation, this cavity was found to contain not pus, but broken-down bone and granulation tissues, which were removed and which yielded living staphylococci aureus. The wound healed and there has been no recurrence of local symptoms.

Discharged from the hospital in March, 1929, the boy complained in April of pain in the upper part of his left arm, severe at night, without swelling, redness, or rise of temperature. There was exquisite bone tenderness four inches below the tip of the acromion. A diagnosis was made of chronic, probably medullary, bone abscess, which was confirmed by röntgenogram. (Fig. 4.) The same operation as in the preceding case was performed on this boy two weeks ago, evacuating thick pus, containing living staphylococci, through a one-eighth inch drill hole. Because the X-ray film showed bony septa in the abscess cavity, a second drilling was made in the lower compartment but no further pus escaped—the cavity was single. The skin wound has shown some infection but is now healing. The pain has ceased.



FIG. 3.—Chronic abscess in patella. (Case II.)

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It was mentioned in these cases that the organisms were living, because very often these chronic bone abscesses are sterile. Simple drill drainage of chronic bone abscesses, in which the patient is afebrile or subfebrile, works as well when the bacteria are living, but probably attenuated, as when they are dead or have disappeared. In those occasional, more acute or more active cases, with fever, freer drainage should be provided.

DR. FENWICK BEEKMAN said that in Bellevue Hospital, many of the patients upon whom they operated some years ago, before they took up conservative methods, are still suffering, for the scars, which are adherent to the bone, break down frequently and in three cases the individuals had fractures, which were necessarily compounded. Since they had taken up conservative treatment a marked improvement in the results could be seen. Most of their cases had secondary operations; a great many of these being for cavities in sclerosed bone. In the last two or three years they have been treating these by means of the Orr technic: removing the roof and edges of the cavity, and the skin being allowed to drop in as far as it would. This was dressed after packing the cavity with vaseline gauze, and a circular plaster casing applied. This was left on until the smell became unbearable. He felt that while this method is not esthetic, the results were good, though the procedure seemed to him to be unsurgical. In cases where sequestra formation had taken place, Doctor Beekman agreed with Doctor Brickner that a sequestrum should not be removed until it had entirely separated and even went so far as to express an opinion that it should not be removed until nature had removed much of it by means of phagocytosis. At Bellevue, they have found that the longer a sequestrum is left, the easier it is to remove through a small incision, and frequently it can be teased out without removing any more of the cortex of the bone. The more one does to the bone, the more scar tissue will form, resulting in lessening the blood supply. In those cases in which there are large sclerosed bones, especially if there is no subcutaneous tissue over them, the scars break down continuously. If the case can be brought through with small scars, the after-results are very much better in every way.

DOCTOR BRICKNER, in closing the discussion, said that chronic bone abscesses are not at all uncommon in cases of osteomyelitis and are not rare in individuals who have not been known to have had osteomyelitis. It is one of the things to think of when an individual has persistent localized pain. Indeed,



FIG. 4.—Chronic medullary abscess of right humerus. (Same person as in Fig. 3.)

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localized pain, often worse at night, is usually the only subjective symptom; commonly there is no fever, swelling, or redness. Localized bone tenderness is the only objective physical sign; and the diagnosis is confirmed by X-ray examination.

He felt that there was another question worth discussing and that is, do these chronic bone abscesses represent continuing infection, or were they present in one phase or another at the time of the original infection? He was inclined to think they were. When, in acute osteomyelitis of one bone, a patient becomes infected with the organisms he often gets a shower of bacteria in other bones, but these sometimes become attenuated and often only long after does local pain reveal the presence of a long-latent distant pus collection. Curiously, at a time when the abscess first gives symptoms the pus may be found sterile. If systematic X-ray examination were made of all the bones in cases of osteomyelitis one would probably sometimes find—in fact, he has found—foci in other bones giving, at the time, no symptoms at all. Primary infection seems also the best explanation of chronic abscess in the original bone which, though residual from the acute osteomyelitis, first gives symptoms fifteen, twenty, or even forty years later.

TREATMENT OF POTT'S FRACTURE, WITH PERSISTENT DEFORMITY

DR. SETH MILLIKEN presented a woman, thirty-seven years of age, who during the evening of February 9, 1929, slipped, injuring the left ankle. She was seen by a competent surgeon who reduced a fracture in the left ankle and applied splints. X-ray the next morning showed renewed displacement. A second reduction was attempted and again splints were applied. The displacement still persisting she came under the care of the reporter.

On the morning of February 13, under anæsthesia, a Steinmann nail was forced through the lower posterior border of the os calcis. The nail was then attached to a cord laid through a pulley elevating the leg at an angle of about forty degrees above the level and fifteen pounds attached to the end of the cord, with the entire weight of the leg from below mid-thigh hung on the Steinmann nail. The lower half of the Gatch bed was sufficiently elevated to support the patient's buttocks and prevent sliding downward.

X-ray taken February 14 showed improvement in the position. February 15 showed partial reduction. February 16 showed complete reduction with fragments in apposition and the lower margin of the tibia restored to normal alignment.

By February 20 all swelling of the foot and ankle had disappeared and the patient could voluntarily move the ankle through a range of about ten degrees. The traction was reduced to ten pounds and the position lowered so that the lower part of the thigh touched the bed. March 13 the nail was removed after applying two lateral and a posterior splint from the toes to the knee. March 15 both wounds were scabbed, no discharge. The patient was allowed to go home on crutches.

April 11 splints were removed, fracture seemed perfectly united and firm. As soon as splints were removed patient had voluntary motion between twenty-five and thirty degrees at ankle without pain. The inner nail hole

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was entirely healed, the outer hole showed small granulation. She could rest the weight of the leg on the floor without pain.

April 26 the patient telephoned she was walking with a chair in front of her without pain.

May 3 she walked without crutches, had twenty-five degrees range of motion in ankle-joint. There is still considerable œdema of leg and foot but muscle tone is considerably regained. Patient is shown twelve weeks from the time the nail was inserted.

This patient was shown because of the bad deformity caused by the fracture, the great difficulty in maintaining the reduction of the fragments and to show a method of obtaining a satisfactory reduction and result without suffering to the patient.

The reporter believed the disability resulting from an incomplete reduction in this type of fracture to be permanent. This method, however, in two cases has given perfect reduction and function.

The continuous motion of a joint in which the articular surfaces are involved in the lesion is of great importance in obtaining satisfactory function after the fragments are reduced.

FUNCTION OF THE GALL-BLADDER

DR. JOSHUA E. SWEET read a paper with the above title, for which see page 939.

DR. CHARLES E. FARR, in commenting on the paper, said that he had never yet found at operation an entirely empty gall-bladder. It is not rare to find the gall-bladder somewhat relaxed, as if the tension were moderately low, but there is nothing to suggest a contracture or spasm of a muscular organ. Every surgeon knows that to empty the gall-bladder even with a normal cystic and common duct requires considerable pressure, far beyond the possibilities of the thin-walled normal organ.

Doctor Farr questioned the sudden emptying of the gall-bladder after the ingestion of the fat meal: first, because at operation even after a hearty meal the gall-bladder is not found empty, and second, because X-rays do not reveal a stream of the opaque dye flowing into the common duct and duodenum. He believes that Doctor Sweet is correct in considering the gall-bladder largely an organ of absorption.

DR. SEWARD ERDMAN said he had always believed the gall-bladder filled and emptied, and referred to an article published several years ago in the *Journal of the American Medical Association* on some experiments by Japanese investigators which seemed very convincing. The statement, he thought, was made at that time that while operating on the human gall-bladder, with a duodenal tube in the duodenum, the surgeons had seen the gall-bladder empty, when magnesium sulphate solution was injected through the tube as is done in the Lyon's test. Furthermore, when faceted gall-stones of a uniform size, color and consistency are found in the stools of patients, after

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an attack of gall-stone colic; and when at operation, a few days later, the gall-bladder is found to contain identical gall-stones, it seems logical to conclude that stones have passed from the gall-bladder to the intestine.

Clinically it is known that removal of the gall-bladder and its stones, in such cases, cures the patient in nearly every instance.

If it be assumed that gall-stones form primarily in the hepatic ducts, and pass thence into the gall-bladder, why does cholecystectomy cure the patient?

EDITORIAL ADDRESS

The office of the Editor of the *Annals of Surgery* is located at 115 Cambridge Place, Brooklyn, New York. All contributions for publication, Books for Review, and Exchanges should be sent to this address.

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ANNALS of SURGERY
227-231 South Sixth Street
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